SPECIFICATIONS

FOR

FY 2012 TASK ORDER CONTRACT
FOR
PAVEMENT MARKINGS

CITY OF SAN ANTONIO

CITY MANAGER
Sheryl L.Sculley

DIRCTOR OF PUBLIC WORKS
Majed Al-Ghafry

TRAFFIC ENGINEERING DIVISION
P.O. BOX 839966
SAN ANTONIO, TX 78283-3966

10/4/11

October 2011

FY 2012 TASK ORDER CONTRACT FOR PAVEMENT MARKINGS
CITY OF SAN ANTONIO
PUBLIC WORKS DEPARTMENT
OCTOBER 2011

TABLE OF CONTENTS

Project Description

Project Scope

The City of San Antonio is soliciting bids from qualified contractor(s) to perform pavement markings maintenance along approximately 100 center line miles of roadway located throughout the City of San Antonio. Services shall include, but are not limited to the placement of pavement marking/markers and the retracing/removal of pavement markings/markers on a task order basis. In addition the selected contractor will also be tasked with completing approximately 26 center line miles of pavement markings associated with the completion of bike lane projects to include the installation of all necessary signage. These services are required by the Traffic Operations Division, a division of the Public Works Department.

Project Duration and Amount

This contract is a Task Order contract and task orders will be provided based on requested projects and available funding. The contract shall be terminated 365 calendar days after the first task order's notice to proceed. The construction time for each task order will be determined by the Project Manager.

Important Notes

1. All work shall follow the 2008 Edition of the "Standard Specifications for Construction" published by the City of San Antonio and any Special Provisions for this contract.

2. All cost associated with the following items shall be included with other applicable items:

    A. Insurance and Bond
    B. Item 100 - Mobilization
    C. Item 101 - Preparing of Right of Way
    D. Item 530 - Barricades, Signs and Traffic Handling
    E. Item 540 - Storm Water Pollution Prevention Plans (SW3P)

3. Unit prices established shall remain valid throughout the duration of the contract.

4. **The quantities shown are estimated quantities used for budgetary purposes only. Awarding this contract does not guarantee the Contractor the entire amount of the work shown in the proposal.**

5. The projects will be assigned as they become available.

CITY OF SAN ANTONIO, TEXAS
GENERAL NOTES

This contract consists of placements of pavement marking/markers (lane line and edge line thermoplastic markings, legends, and raised pavement markers) and retracing/removal of pavement markings/markers (lane line and edge line thermoplastic markings, legends and raised pavement markers) throughout the City of San Antonio on a task order basis.

Several road segments needing pavement markings have been identified for possible completion under this contract. These locations are provided for planning purposes and are subject to change at the discretion of the project manager. Potential road segments to be completed under this contract include:

	Street	From	To	CLM	District
1	Blanco Rd	Fredericksburg Rd	Loop 410	5.1	1
2	Cypress St W	San Pedro	McCullough	0.4	1
3	Flores	Fredericksburg	Ashby	0.4	1
4	Jackson Keller	Vance Jackson	McCullough	3.2	1
5	Moss Rock	Vance Jackson	Cherry Ridge	0.8	1
6	N St Mary's	Josephine	E Mulberry Ave	0.9	1
7	San Pedro Ave	NW Loop 410	W Quincy	6.0	1
8	Vance Jackson Rd	Fredericksburg Rd	Loop 410	2.6	1
9	Vance Jackson	Loop 410	Jackson Keller	0.5	1
10	W Mulberry	San Pedro	US HWY 281 N	1.0	1
11	Jones Maltsberger	Isom	Basse	2.9	1,9
12	W Mulberry	US HWY 281	Broadway	0.6	1,9
13	E Commerce	IH 37 S	E Houston	3.4	2
14	N Rio Grande	Martin Luther King Dr	Hays St	1.1	2
15	S Walters	Westfall Ave	E Houston	1.5	2
16	Roland Ave	S WW White Rd	IH 10	3.2	2,3
17	E Southcross Blvd	S Flores St	IH 410	6.4	3
18	Ashley Rd	Roosevelt Ave	Pleasanton	1.2	3
19	Applewhite Rd	Hwy 16	Old Apple White Rd	4.3	3,4
20	Apple Valley Dr	Haven Valley	Ray Ellison Dr	0.6	4
21	Somerset Rd	IH 410	W Gerald Ave	4.9	4
22	Somerset Rd	W Gerald Ave	S Zarzamora St	0.8	4,5
23	24th, 26th, Cupples, Quintana	Culebra	Gerald	5.7	5
24	SW 19th St	Saltillo St	W Poplar St	2.0	5
25	W Commerce	S Gen McMullen	IH 35 S	3.2	5
26	W Southcross Blvd	Quintana Rd	Somerset Rd	1.2	5
27	W Commerce	SW 36th	S Gen McMullen	1.1	5,6
28	Bowens Crossing	IH 1604	Trendwood	1.1	6
29	Dover Ridge	Trendwood	Tezel Rd	1.7	6
30	Farragut	Callaghan	Oak Hill Rd	0.5	6

	Street	From	To	CLM	District
31	Tezel	Timberpath	Grissom	0.4	6
32	Westfield Blvd	Spur Rd	Old US Hwy 90	1.5	6
33	Westover Hills Blvd	N Ellison Dr	Culebra Rd	2.4	6
34	W Commerce	W Military Dr	S Callaghan	2.0	6
35	W Commerce	S Callaghan	SW 36th	1.7	6,7
36	E Sunshine	Hillcrest Dr	Babcock Rd	1.5	7
37	Wilson Blvd	Culebra Rd	Babcock Rd	1.8	7
38	Bluemel Rd	Fredericksburg Rd	Wurzbach Rd	1.0	8
39	Sonoma Pkwy	Kyle Seale	Hausman	1.5	8
40	Babcock Rd	Hamilton Wolfe	Callaghan Rd	2.5	8
41	Network Blvd	Prue Rd	Northwest Pkwy	0.7	8
42	Medical Dr	IH 10W Access	Babcock	2.5	8
43	Broadway	Claywell	NE Loop 410	1.4	9
44	Jones Maltsberger	Thousand Oaks	US HWY 281 N	3.9	9
45	Parkridge Dr	Vidor Ave	Airport	0.4	9
46	Starcrest	Jones Maltsberger Rd	Wurzbach Pkwy	1.8	9
47	Sunset Rd E	Broadway	New Braunfels	0.4	9
48	Broadway	Wetmore Rd	NE Loop 410	1.8	10
49	Jones Maltsberger	Morning Trail	Thousand Oaks	0.2	10
50	Stahl Rd	Higgins Rd	Nacogdoches Rd	3.2	10
51	Urban Crest	N Vandiver Rd	Harry Wurzbach Rd	0.4	10

There have been 31 bike lane projects identified for possible completion under this contract. These locations are provided for planning purposes and are subject to change at the discretion of the project manager. Potential bike lane projects to be completed under this contract are located within the following road segments:

	Street	From	To	CLM	District
1	Flores St	Ashby	Fulton	0.8	1
2	Briarglen	Highcliff	Perrin Beitel	0.4	2
3	Midcrown	Walzem	Woodlake Parkway	2.7	2
4	Pecan Valley	Dollarhide	Roland	2.2	3
5	Adams Hill	Ellison	Hunt	0.9	4
6	Ellison	Military	Wiseman (Ellison)	1.6	6
7	Rogers	151	Westover Hills (Rogers)	1.4	6
8	Ellison	Dugas	Adams Hill	1.5	6
9	Cable Ranch Pkwy	151	Marbach	1.3	6
10	Abe Lincoln	Horn	Eckhert	1.4	7
11	Whitby	leon Creek Trail Head	Abe Lincoln	0.4	8
12	Roadrunner Way	Hausman	UTSA Blvd	0.5	8
13	Walker Ranch	Bitters	WoodValley	1.2	9
14	Wood Valley	Walker Ranch	Bitters	0.6	9
15	Woodlake PKWY	Walzem	Gibbs Sprawl	1.6	2
16	Frio City Road	Brazos	Malone	2.1	5
17	Brazos	Saltillo	Frio City Rd	0.2	5
18	Thompson Place**	Growdon	Cupples	0.8	5
19	Thompson Place**	Cupples	SW 21st	0.6	5

	Street	From	To	CLM	District
20	Growdon Rd	36th/Frank Luke	Thompson Place	0.9	4
21	Lakeside Parkway	Cable Ranch	Ingram	0.5	6
22	Cinnamon Hill	Gus Eckert Rd	Hamilton Wolfe	0.8	8
23	StarCrest	410	Barrington	0.6	10
24	StarCrest	410	high cliff	0.2	10
25	Highcliff	Starcrest	Briarglen	0.4	10
26	St. Marys	US 281	Lexington	1.9	1
27	Woodstone	Vance Jackson	IH 10	0.8	8
28	Micron	Culebra	Potranco	1.0	6
29	Pipers Lane	Culebra	Pipers Way	0.5	6
30	Parliament	Blanco	Patricia	0.3	9
31	Larkspur	Braesview	Baltic	0.5	9

Placement of pavement markings/markers must be in accordance with the Texas MUTCD and the applicable City of San Antonio Standard Sheets.

Workers exposed to traffic will be attired in bright, highly visible clothing at all times and all workzone safety rules must be adhered to.

Retracing locations will be provided to the Contractor at the pre-work meeting.

The Contractor shall continuously execute work until work is completed.

Task Orders will be coordinated with Contractor prior to issuance, however Contractor is expected to be sufficiently staffed to complete multiple task orders if needed.

The Contractor shall complete the placement of raised reflective pavement markers, legends, stop bars, and crosswalks within ten (10) calendar days following the placement of long lane thermoplastic pavement markings.

A written schedule of work is required before beginning work. Any deviation from this schedule will require approval.

Item 101: Preparing Right – of – Way

Preparing Right – of – Way includes removal of all debris and obstacles to apply pavement markings on pavement surface.

Item 530: Barricades, Signs & Traffic Handling

Furnish and install all signs, barricades, and other incidentals necessary for proper traffic control, in accordance with Part VI of the Texas MUTCD and as directed all warning signs shall be factory made and in satisfactory condition.

Shadow vehicles equipped with Truck Mounted Attenuators (TMA) may be required for long lane applicator and raised pavement marking applications as shown in the standard sheet.

Lane closures will require prior approval from the City Traffic Engineer. Notify the City Traffic Engineer 48 hours in advance of lane closures.

Normal working hours will be 9 a.m. to 4 p.m., Monday through Friday. When directed, high traffic volumes in urban areas will require work during non-peak hours, weekends, and nights. No work to be performed on Saturdays, National holidays or State observed holidays unless otherwise shown on plans or approved. Note that if weather conditions allow night application; then the night construction is acceptable.

Traffic control setup and maintenance will not be paid for directly, but will be subsidiary to the various bid items.

Item 531: Signs

All signage will be installed in accordance with Texas MUTCD and applicable City of San Antonio Standard Sheets.

All signage will be manufactured to meet City of San Antonio Standard Sheets.

Silk Screening will not be accepted.

Sign location changes will be cleared with City Traffic Engineer prior to installation.

Obtaining locates on sign locations will be the full responsibility of the Contractor.

Item 533: Striping Obliteration

Remove all existing raised reflective pavement markers and markings as directed by the engineer or inspector. Removal of existing raised reflective pavement markers and markings will be paid for directly within the various bid items.

Supplemental markers will be used only as directed.

Damage to the roadway caused by removing pavement markers will be repaired by the Contractor at contractor's expense. Fill holes with asphaltic material is an approved method.

Some locations will require the existing pavement markings to be eliminated in accordance with this item.

Some locations will require elimination of existing pavement markings due to excessive build up to pavement marking material. These locations will also require the elimination of existing raised pavement markers where they are present. Removal of all existing raised pavement markers and markings will be paid for directly within the various bid items.

Due to the variation of the roadway surface remove pavement markings to the pavement surface unless otherwise directed.

Covering of existing markings with seal coat or paint, etc. is not permitted unless approved by project manager.

When removing thermoplastic pavement markings on a concrete surface, seal the surface with an acrylic sealer before the installation of new thermoplastic pavement marking in completed.

Item 535: Hot Applied Thermoplastic Pavement Markings

Place pavement markings and markers in accordance with the Texas MUTCD and the City of San Antonio Standard Sheets. Word and symbol legends square footage will be determined based on pre-determined square footages shown in the attached standard sheet.

The Contractor shall avoid shadow effect when retracing by applying slightly wider striping to cover old existing markings. Application of slightly wider striping to avoid shadow effect will not be paid directly, but will be subsidiary to the various bid items.

Sealers are not required for pavement surfaces older than two years as part of this program.

Sealer may be required when legends and symbols are installed, if the inspector determines pavement condition will not allow proper adhesion of thermoplastic material to the pavement surface. Application of sealer will not be paid for directly.

All water based paint shall conform to the requirements of TxDOT DMS-8200 "Traffic Paint". Water based paint will only be applied on newly paved roadway surfaces per the requirement of "Item 535.4 CONSTRUCTION", to provide temporary pavement marking during the 14 to 35 day waiting period. This item will be paid for directly within the various bid items.

If the pavement surface is not smooth enough to apply legends and symbols according to City inspector's requirement, the Contractor can use only Inlaid Performed Pavement Marking according to the requirements of "Item 536. PERFORMED PAVEMENT MARKINGS." Performed legends and symbols will not be paid directly, but will be

subsidiary to square footage for legends and symbols based on pre-determined square footage shown in the attached standard sheet.

Item 537: Raised Pavement Markers

Place raised reflective pavement markers at locations indicated in the work orders. All existing raised reflective pavement markers that are to remain in place, and are damaged due to Contractor neglect, will be removed and replaced at the Contractor's expense.

CITY OF SAN ANTONIO, TEXAS
GOVERNING SPECIFICATIONS

All City of San Antonio Standard Specifications and special specifications applicable to this project are identified as follows:

CITY OF SAN ANTONIO
STANDARD SPECIFICATIONS FOR CONSTRUCTION
JUNE 2008 AND LATEST REVISIONS

ITEM	DESCRIPTION
100	MOBILIZATION
101	PREPARING RIGHT-OF-WAY
530	BARRICADES, SIGNS & TRAFFIC HANDLING
531	SIGNS
533	STRIPING OBLITERATION
535	HOT APPLIED THERMOPLASTIC PAVEMENT MARKINGS
536	PERFORMED PAVEMENT MARKINGS
537	RAISED PAVEMENT MARKERS
540	TEMPORARY EROSION, SEDIMENTATION AND WATER PREVENTION AND CONTROL
	BIKE LANE MARKINGS
1000	WEB PORTAL

DIVISION I - EARTHWORK

ITEM

100 MOBILIZATION

100.1. DESCRIPTION: *Establish and remove offices, plants, and facilities. Move personnel, equipment, and supplies to and from the project or the vicinity of the project site to begin work or complete work on Contract Items.*

100.2. MEASUREMENT: This Item will be measured by the lump sum as the work progresses.

100.3. PAYMENT: Partial payments of the lump sum bid for mobilization will be as follows. The adjusted Contract amount for construction Items as used below is defined as the total Contract amount less the lump sum for mobilization.

A. Payment will be made upon presentation of a paid invoice for the payment bond, performance bond, and required insurance. The combined payment for bonds and insurance will be no more than 10% of the mobilization lump sum or 1% of the total Contract amount, whichever is less.

B. Payment will be made upon verification of documented expenditures for plant and facility setup. The combined amount for all these facilities will be no more than 10% of the mobilization lump sum or 1% of the total Contract amount, whichever is less.

C. When 1% of the adjusted Contract amount for construction Items is earned, 50% of the mobilization lump sum bid or 5% of the total Contract amount, whichever is less, will be paid. Previous payments under this Item will be deducted from this amount.

D. When 5% of the adjusted Contract amount for construction Items is earned, 75% of the mobilization lump sum bid or 10% of the total Contract amount, whichever is less, will be paid. Previous payments under the Item will be deducted from this amount.

E. When 10% of the adjusted Contract amount for construction Items is earned, 90% of the mobilization lump sum bid or 10% of the total Contract amount, whichever is less, will be paid. Previous payments under this Item will be deducted from this amount.

F. Payment for the remainder of the lump sum bid for "Mobilization" will be made on the next estimate cycle after the initial retainage estimate or at final acceptance for projects without retainage.

100.4. BID ITEM:

Item 100.1 - Mobilization - lump sum

Item 100.2 - Insurance and Bond - lump sum

ITEM

101 PREPARING RIGHT-OF-WAY

101.1. DESCRIPTION: *Prepare the right of way and designated easements for construction operations by removing and disposing of all obstructions when removal of such obstructions is not specifically shown on the plans to be paid by other Items.*

101.2. MATERIALS:

A. Obstructions. Obstructions shall be considered to include, but not limited to, remains of houses not completely removed by others, foundations, floor slabs, concrete, brick, lumber, plaster, cisterns, septic tanks, basements, abandoned utility pipes or conduits, equipment or other foundations, fences, retaining walls, outhouses, shacks, and all other debris as well as buried concrete slabs, curbs, gutters, driveways, and sidewalks.

This item shall also include the removal of trees, stumps, bushes, shrubs, brush, roots, vegetation, logs, rubbish, paved parking areas, miscellaneous stone, brick, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron and all debris, whether above or below ground, except live utility facilities.

It is the intent of this specification to provide for the removal and disposal of all obstructions to the new construction together with other objectionable materials not specifically provided for elsewhere by the plans and specifications.

B. Explosives. This item shall not govern for the demolition of buildings by the use of explosives. Such demolition work shall be governed by the use of a special specification controlling the work.

C. Fences. Unless shown otherwise on the plans, all fences along the right-of-way which are damaged or removed temporarily by the Contractor shall be replaced by the Contractor to an equal or better condition at no additional cost to the City.

D. Hazardous Materials. If the Contractor encounters hazardous substances, industrial waste, other environmental pollutants, underground storage tanks, or conditions conducive to environmental damage, Contractor shall immediately stop work in the area affected and report the condition to the Owner's representative in writing. Contractor shall not be responsible for or required to conduct any investigation, site monitoring, containment, cleanup, removal, restoration or other remedial work of any kind or nature (the "remedial work") under any applicable level, state or federal law, regulation or ordinance, or any judicial order. If the Contractor agrees in writing to commence and/or prosecute some or all of the remedial work, all costs and expenses, to include any extension of the contract time, of such remedial work shall be paid by Owner to Contractor as additional compensation.

101.3. EQUIPMENT: Provide applicable equipment to conduct work as described in this specification or as specified on the plans.

101.4. CONSTRUCTION: Protect designated features on the right of way and prune trees and shrubs as directed. Do not park equipment, service equipment, store materials, or disturb the root area under the branches of trees designated for preservation. When shown on the plans, treat cuts on trees with an approved tree wound dressing within 20 min. of making a pruning cut or otherwise

causing damage to the tree. Follow all local and state regulations when burning. If burning of brush is approved, pile and burn at approved locations. When working in state or national forests or parks, coordinate work with state and federal authorities. Testing, removal, and disposal of hazardous materials will be in accordance with 101.2.D, "Hazardous Materials."

Clear areas shown on the plans of all obstructions, except those landscape features that are to be preserved. Such obstructions include but are not limited to those identified in 101.2.A, "Obstructions" and other items as specified on the plans. Remove vegetation and other landscape features not designated for preservation. Removal of live utility facilities is not included in this Item. Remove culverts, storm sewers, manholes, and inlets in proper sequence to maintain traffic and drainage.

Unless otherwise indicated on the plans, all underground obstructions shall be removed to the following depths:

- In areas receiving embankment, remove obstructions not designated for preservation to 2 ft. below natural ground.
- In areas to be excavated, remove obstructions to 2 ft. below the excavation level.
- In all other areas, remove obstructions to 1 ft. below natural ground.

When allowed by the plans or directed, cut trees and stumps off to ground level.

Holes remaining after removal of all obstructions, objectionable materials, vegetation, etc. shall be backfilled and tamped and the entire area bladed, to prevent ponding of water and to positive provide drainage. Backfill materials deemed unacceptable by the Engineer shall be removed and replaced at no additional cost to the City. In areas that are to be immediately excavated, backfilling and blading may be eliminated if approved by the Engineer. Areas to be used as borrow sites and material sources shall have all obstructions, objectionable materials, vegetation, etc., removed to the complete extent necessary to prevent such objectionable matter from becoming mixed with the material to be used in the construction.

Where a conduit is shown to be replaced, it shall be removed in its entirety and all connections to the existing conduit shall be extended to the new line. Where an existing conduit is to be cut and plugged, the line shall be cut back not less that 2 feet and a plug of concrete not less that 2 feet long shall be poured and held in the end of the pipe or the plug may be accomplished by using a precast stopper grouted into place.

Material to be removed will be designated as "salvageable" or "non-salvageable" on the plans prior to bidding by the Contractor. All "salvageable" material will remain the property of the City and will be stored at the site as directed by the Engineer. All "non-salvageable" materials and debris removed shall become the property of the Contractor and shall be removed from the site and shall be disposed of properly and in accordance with local, state, and federal requirements.

All asphaltic material shall be deposited of or recycled at a facility authorized to accept the asphalt for such purposes.

Dispose of wells in accordance with TxDOT Item 103, "Disposal of Wells."

101.5. MEASUREMENT: "Preparing Right-of-Way" for new construction will be measured by the lump sum.

101.6. PAYMENT: This item will be paid for at the contract lump sum price bid for "Preparing Right-of-Way," which price shall be full compensation for work herein specified, including the furnishing of all materials, equipment, tools, labor, and incidentals necessary to complete the work. The lump sum price will be pro-rated based on the number of phases in the project. A phase will be eligible for payment when street excavation is completed for that phase.

101.7. BID ITEM:

Item 101.1 - Preparing Right-of-Way - lump sum

ITEM

530 BARRICADES, SIGNS, AND TRAFFIC HANDLING

530.1. DESCRIPTION: *This item shall govern for providing, installing, moving, repairing, maintaining, cleaning and removing upon completion of work, all barricades, signs, cones, lights and other such type devices and of handling traffic as indicated on the plans or as directed by the Engineer.*

530.2. GUIDELINES FOR BARRICADING ON CITY RIGHT-OF-WAY: The barricade contractor must locally maintain sufficient materials in stock to accommodate three or more construction phases per project. These will include all applicable traffic control sign types, trucks, trailers, arrow boards, and all other traffic control devices assigned to the Contractor's barricading operation.

The *Texas Manual on Uniform Traffic Control Devices (TMUTCD)*, Section 6A-6, requires the appropriate training for all personnel who are involved in the selection, placement, and maintenance of traffic control devices on construction projects. The City of San Antonio requires that all personnel associated with barricading operations and traffic handling possess certificates from either of the two groups listed in Table 1 below. Each certificate will be valid for four years.

Table 1
Barricading Training

Texas Engineering Extension Service	American Traffic Safety Service Association
Work Zone Traffic Control	Training Course for Worksite Traffic Supervisors

The Contractor shall have a minimum of one barricade supervisor and three persons who are responsible for construction work zone traffic control. These persons shall be based in the San Antonio metropolitan area and their sole tasks shall be implementing and maintaining construction work zone traffic control devices.

The Contractor shall have a commercial telephone answering service during non-working hours. The Contractor shall provide the City during working hours with an office telephone number, pager number, and cellular telephone number to contact the barricading supervisor. The contractor must be able to respond to any call within two hours. The barricading contractor or General Contractor must possess liability insurance in the minimum amount of one million dollars. A copy of the liability policy must be sent to the City Traffic Engineer for approval 48 hours prior to starting barricading operations.

The contractor shall comply with all standards set forth in the plan barricade detail sheets. One noncompliance letter issued by the City to the Contractor in regard to construction work zone traffic control, and not corrected within 48 hours, will be cause for delay of payment for this item.

If the general contractor elects to do his own barricading, he must comply with all the foregoing requirements. Additionally, a general contractor will be required to submit a traffic control plan (TCP) at least 72 hours in advance (excluding weekends and holidays) of starting work in each construction phase. Upon satisfactory evidence of competent barricading expertise, this requirement for a traffic control plan may be waived by the City Traffic Engineer.

530.3. EQUIPMENT: Provide the machinery, tools and equipment necessary for proper prosecution of the work. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

530.4. CONSTRUCTION: All barricades, signs, and other types of devices listed above shall conform to the requirements of the TMUTCD. It is the contractor's responsibility to see that all traffic control devices are properly installed and maintained at the job site. If it is determined by the Traffic Engineering Representative that the traffic control devices do not conform to the established standards, or are incorrectly placed to protect the general public, the Traffic Engineer shall have the option to stop the work, at no expense to the City, until the situation is corrected by the Contractor. If it is determined that additional temporary traffic control devices, special directional devices, and/or business name signs are required, they will be provided by the contractor at no additional cost. As work progresses, the location of temporary traffic control devices will be adjusted and modified as necessary by the Contractor.

All retro reflective traffic control devices such as barricades, vertical panels, signs, etc., shall be maintained by cleaning, replacing or a combination thereof such that during darkness and rain, the retro reflective characteristics shall equal or exceed the retro reflective characteristics of the standard reflective panels in the Inspector's possession.

The contractor shall contact the City of San Antonio Traffic Operations Section prior to removing any traffic signs or traffic signals. Prior to completion of the contract and removal of barricades, all applicable permanent traffic signs and signals must be in place and functioning properly. All permanent signs or traffic control devices missing or damaged during construction shall be replaced at the contractor's expense. Permanent pavement marking shall be applied prior to the opening of any street to traffic. Temporary short-term expendable pavement markings may be provided prior to application of permanent markings.

The contractor must maintain all streets open to through traffic by repairing trenches, potholes, etc., at no direct payment. The contractor shall provide reasonable access to residences and all businesses within all phases of the work, as well as providing suitable access accommodations for school children, pedestrians, garbage pick-up and mail delivery by the US Postal Service. Temporary pedestrian crossing will be determined in the field by the Police Department School Services Unit. Temporary pedestrian crossings shall be 4 feet wide by 4 inches thick asphalt treated base or asphaltic concrete and will be paid for under Item 206, "Asphalt Treated Base" or Item 205, "Hot Mix Asphaltic Concrete Pavement," respectively.

When flagging is required by the plans or Traffic Control Plan, provide a Contractor representative who has been certified as a flagging instructor through courses offered by the Texas Engineering Extension Service, the American Traffic Safety Services Association, the National Safety Council, or other approved organizations. Provide the certificate indicating course completion when requested. This representative is responsible for training and assuring that all flaggers are qualified to perform flagging duties. A qualified flagger must be independently certified by one of the organizations listed above or trained by the Contractor's certified flagging instructor. Provide the Engineer with a current list of qualified flaggers before beginning flagging activities. Use only flaggers on the qualified list.

Flaggers must be courteous and able to effectively communicate with the public. When directing traffic, flaggers must use standard attire, flags, signs, and signals and follow the flagging procedures set forth in the TMUTCD.

530.5. MEASUREMENT: This item will be measured by "Lump Sum" as indicated on the plans.

530.6. PAYMENT: This item will be paid for at the contract lump sum price bid for "barricades, signs, and traffic handling". This price shall be full compensation for furnishing all labor, materials, supplies, equipment and incidentals necessary. To complete the work as specified. The lump sump price will be pro-rated based on the number of workdays in the project contract. Failure to complete the work within time allowed in the project contract due to approving designs, testing, material shortages, closed construction season, curing periods, and testing periods will not qualify for additional compensation. When additional work is added by an approved field alteration or when work is suspended for the convenience of the City, through no fault of the contractor, additional compensation may be paid to the Contractors.

530.7. BID ITEM:

Item 530.1 - Barricades, Signs and Traffic Handling - lump sum

ITEM

531 SIGNS

531.1. DESCRIPTION: *Furnish retroreflective and nonretroreflective signs constructed of aluminum substrate to the dimensions specified and install signs of varying sizes and legends as shown on the plans or as specified by the Engineer.*

531.2. MATERIALS: The following ASTM Standards and documents, of the issue in effect on the date of Invitation for Bid, form a part of this specification to the extent herein.

A. ASTM B 209 Specification for Aluminum and Aluminum Alloy Sheet and Plate

B. ASTM D 523 Standard Method for Test for Specular Gloss

C. ASTM D 4956 Standard Specification for Retroreflective Sheeting for Traffic Control

D. ASTM E 284 Standard Definition of Terms Relating to Appearance of Materials

E. ASTM E 308 Computing the Colors of Objects by Using the CIE System

F. ASTM E 810 Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting

G. ASTM E 1164 Standard Practice for Obtaining Spectrophotometric Data for Object-Color Evaluation

H. CIE Publication Number 39-2, Recommendation for Surface Colors for Visual Signaling

I. FP-92 Standard Specifications for Construction of Roads and Bridges on Federal Highway Project

J. Substrate. This shall be aluminum alloy 5052-H38 and otherwise in conformance with ASTM B-209 and have gold chromate finish. The size, shape and thickness of the sign blanks are as indicated on the standard detail sheet in the plans or as specified by the Engineer.

1. **Metal working.** The aluminum shall be free of burrs and pits on both sides, including edges and holes, and shall be made ready for applications of the sheeting.

2. **Surface Preparation.** The aluminum shall be thoroughly cleaned and degreased with solvent and alkaline emulsions cleaner by immersion, spray, or vapor degreasing and dried prior to application of the gold chromate sheeting coat.

   The aluminum shall be new and corrosion-free with holes drilled or punched, corners rounded to the radii shown in the standard detail sheet, and all edges smoothed prior to application of sheeting. The heavy or medium chromate coating shall conform in color and corrosion resistance to that imparted by the Alodine 1200F treatment.

3. **Size.** The dimensions of substrate applications for regulatory, warning, and guide signs shall be as specified by the Engineer and as shown on the plans.

K. Background, Legends, Symbols, and Colors. These shall be in accordance with the Standard Highway Sign Designs (SHSD) for Texas and with the Texas Manual of Uniform Traffic Control Devices (TMUTCD).

1. **Retroreflective Materials.** Retroreflective materials shall comply with "Standard Specifications for construction of Roads and Bridges on Federal Highway Projects", FP-85 and Federal Specifications L-S-300C. The Contractor shall furnish a certification that the materials comply with the requirements of FP- 85 and L-S-300C.

   a. **Retroreflective Sheeting.** Type III (High Intensity): The materials as listed in these specifications shall comply with FP-85, Section 718 and L-S-300C. Colors shall be as specified in specifications for Standard Highway Sign Colors (FHWA, HTO-21).

   b. **Retroreflective Sheeting.** Type IX (Diamond Grade Fluorescent yellow green, VIP Reflective Sheeting): The materials shall comply with ASTM 4956. Designed to provide higher nighttime sign brightness in the legibility distance and brightness at high entrance angles. The minimum fluorescence luminance factor (YF) for new sheeting shall be 35%.

2. **Electronically Cuttable Film.** Electronically cuttable film shall consist of flexible, transparent, durable acrylic colored films coated with a transparent pressure sensitive adhesive protected by a clear removable liner. These films are designed to be applied to retroreflective materials for the creation of traffic control signs and devices by either cutting by knife over roll (sprocket fed or friction fed) and flat bed electronic cutting machines. The films shall be available in standard traffic colors, be dimensionally stable, and be designed to optimally cut, weed, lift, and transfer. Use of electronic cuttable films will not require the release of any volatile organic compounds.

   When electronic cuttable film is applied to retroreflective sheeting, the resulting color of the composite sheeting will conform to Federal Specification FP-92, Section 718.01 and ASTM D 4956 or to the using agency specification for the appropriate retroreflective sheeting to which it is applied.

   Only signage utilizing electronically cuttable film will be allowed. Silk screened sign faces will not be accepted.

   a. **Color Test.** Conformance to color requirements shall be determined by instrumental method in accordance with ASTM E 1164 on sheeting applied to aluminum test panels. The values shall be determined on a HunterLab Labscan 6000 0/45 Spectrocolorimeter with option CMR 559 [or approved equal 0/45 (45/0) instrument with circumferential viewing (illumination)].

      Computations shall be done in accordance with ASTM E 308 for the 2° observer.

   b. **Coefficient of Retroreflection R^.** When electronic cuttable film is applied to retroreflective sheeting, the composite will conform to the percentage retained of the minimum coefficient of retroreflection specified by the using agency and the manufacturer for the retroreflective sheeting when the retroreflective sheeting is screen processed. The coefficient of retroreflection shall be determined in accordance with ASTM E 810. Coefficients of retroreflection R^ shall be specified in units of candelas as per foot candle per square foot (candelas per lux per square meter). The observation angles shall be 0.2 and 0.5 degrees unless otherwise specified. The

entrance angles shall be –4 and 30 degrees unless otherwise specified. The electronic cuttable film shall have and 85° specular gloss of not less than 50 when tested in accordance with ASTM D 523.

c. **Processing and Cuttability.** The electronic cuttable film shall permit cutting, weeding, masking with transfer tape, lifting, and application to retroreflective sheeting when used in accordance with manufacturer's recommendations at temperatures between 65° and 95° F and relative humidifies between 30% and 70%. The film shall lay flat with minimal edge curl and be dimensionally stable.

d. **Adhesive Liner.** The protective liner attached to the adhesive shall be removable by peeling without soaking in water or other solutions, without breaking, tearing, or removing any adhesive from the electronic cuttable film. The liner shall have a controlled release from the adhesive coated film sufficient to allow cutting without the film popping off from the liner while still allowing the liner to easily be peeled from the film.

e. **Film.** Film with punched edges for use on sprocket fed knife over roll cutters shall be edge scored and weeded to remove film in the punched area as a means of eliminating adhesive build up on the sprockets.

f. **Resistance to Accelerated Outdoor Weathering.** When electronic cuttable film is applied to retroreflective sheeting, the surface of the film shall be weather resistant and show no appreciable cracking, blistering, crazing, or dimensional change after 2 years unprotected outdoor exposure, facing the equator and inclined 45° from the vertical. Following weather exposure, panels shall be washed in a 5% HCl solution for 45 seconds, rinsed thoroughly with clean water, blotted dry with a soft cloth and brought to equilibrium at standard conditions.

After cleaning, the coefficient of retroreflection shall not be less than the value specified by the using agency for the retroreflective sheeting when the retroreflective sheeting is screen processed. Show no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting or curling or more than 1/32 inch shrinkage or expansion. Show good color fastness or better when tested. The electronic cuttable film shall not be removable from the retroreflective sheeting without damage.

g. **Sign Face.** The sign face, made of electronic film and retroreflective sheeting shall comply with the appearance, specification, and good workmanship designated by the using agency for sign faces constructed of screen processed retroreflective sheeting of the same type.

3. **Non-Retroreflective Sheeting.** All letters, numerals, and symbols shall be as prescribed in this specification.

4. **Application Methods.** The method of application of sheeting, letters, numbers, and symbols shall be precisely as prescribed in writing by the manufacturer.

a. **Legend Spacing and Layout.** Spacing and layout for all traffic control signs shall conform to the SHSD.

b. **Tolerance for Horizontal Alignment.** Letters, numerals, and symbols shall be horizontally aligned to a tolerance of 1/16 inch. Test of each sign board shall be as follows:

(1) Place a metal straight edge along the bottom of a series of letters forming each line of the sign. In each line, letters shall not vary more than 1/16 inch from that line.

c. **Tolerance for Vertical Alignment.** Letters, numerals, and symbols shall be vertically aligned to a tolerance of 1/16 on each letter in each line:

(1) Place a metal straight edge along the bottom edge of a series of letters forming each line of the sign. Place a square along the straight edge and test the trueness of the vertical faces of individual letters. Letters shall be normal to the square within 1/16 inch.

L. Sign Posts. Steel post shall conform to the standard specification for hot rolled carbon sheet steel, structural quality, ASTM designation A570, Grade 50. Average minimum yield strength after cold forming is 60,000 psi. The cross section of the post shall be square tube formed steel, carefully rolled to size and shall be welded directly in the corner by high frequency resistance welding or equivalent process and externally scarified to agree with corner radii. Sign posts shall be hot dipped galvanized conforming to ASTM A653, G90.

1. **Sizes.** Perforated sign posts, anchors and sleeves shall be of the following size:

Size	USS Gauge	Weight
1½" X 1½"	14	1.71
1¾" X 1¾"	14	1.71
2" X 2"	12	2.42
2¼" X 2¼"	12	2.77

Holes shall be 7/16 ± 1/64 inches in diameter on one inch centers on all four sides down the entire length of the post. On square tubing, holes shall be on centerline of each side in true alignment and opposite each other directly and diagonally. The length of each post shall have a permissible length tolerance of ± ¼".

The finished posts shall be straight and have a smooth, uniform finish. It shall be possible to telescope all consecutive sizes of square tubes freely and for not less than ten feet of their length without the necessity of matching any particular face to any other face. All holes and ends shall be free from burrs and ends shall be cut square.

a. **Tolerance on Outside Sizes.**

Nominal Outside Dimension	Outside Tolerances at Corners
1½" X 1½"	±0.006"
1¾" X 1¾"	±0.008"
2" x 2"	±0.008"
2¼" X 2¼"	±0.010"

Note: Measurement from outside dimensions shall be made at least 2 inches from the end of the tube.

Permissible variation in wall thickness is +0.011", -0.005".

Convexity and concavity shall be measured in the center of the flat sides, tolerance in ±0.010", determined at the corner.

b. Squareness of Sides and Twist Permissible in 3" Length.

Nominal Outside Dimension	Squareness Tolerance	Twist
1½" x 1½"	±0.009"	0.050"
1¾" x 1¾"	±0.010"	0.062"
2" X 2"	±0.012"	0.062"
2¼" X 2¼"	±0.014"	0.062"

Permissible variation in straightness is 1/16 of an inch in 3 feet. The standard outside corner radius shall be 5/32 of an inch ±1/64 inch.

2. **Installation.** The square end of the post shall not be modified or pointed.

   a. **Flange.** When sign post installation is required over building basements, bridges and cavities, a galvanized cast iron pipe flange shall be used. The base shall be 8 inches in diameter with six 5/16 inch holes drilled equidistant around the circumference, ⅝ inch from the outer edge. The neck of the flange shall be 3inches in diameter, drilled and threaded to receive a 2 inch diameter galvanized post.

   b. **Hardware.** All ground mounted signs shall be attached to posts using ⅜" aluminum drive rivets. Stainless steel banding material, brackets and clips will be used for signs installed on light standards or mast arms.

   c. **Construction.** Anchors shall be anchored in a minimum of one cubic foot of class "C" concrete, 28 inches deep, with a 6 inch long, ⅜ inch diameter pin inserted through the pre-drilled hole 3 inches from the bottom of the pole. Where the pole installation requires surface mounting, an 8 inch flange with a 2 inch threaded collar shall be used. The pole shall be galvanized, two inches in diameter and threaded to fit the flange. Sign placement and orientation shall be as specified in the construction plans.

M. Anti-Vandalism and Maker's Mark Decals. The anti-vandalism decal shall be installed on the back bottom left corner of the sign. Decals will be supplied by the Traffic Operations Section (207-7765). Each sign shall be permanently marked on the lower right corner of the back side with the month and year of installation, and name of manufacturer.

N. Warranty. The Contractor shall warrant the materials and workmanship of each sign in accordance with the maximum limits of material warranties extended by manufacturers of raw materials, subject to the conditions they specify. Type III and Type IX, Fluorescent Yellow Green, sheeting processed and applied to sign blank materials in accordance with sheeting manufacturer's recommendations, shall perform effectively for the number of years stated in Tables 1 and 2 of this specification. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or (2) the coefficient of retroreflection is less than the minimum specified for that sheeting during that period listed in Tables 1 and 2. When sign failure occurs prior to the minimum years indicated and an inspection demonstrates that the failure is

caused by materials warranted to contractor to endure at least that long, the sign will be replaced or repaired free of materials charges. When failure occurs and inspection demonstrates that such failure is due to poor workmanship, the sign will be replaced or repaired at Contractor's expense, including shipping charges.

Table 1
Minimum Coefficient of Retroreflection
[0.2° observation angle and -4° entrance angle]

Type III Sheeting: 10 Year Life Span	
Sheeting Color	**Candelas per Foot - Candle per Sq. Ft.**
White	250
Yellow	170
Green	45
Red	45
Blue	20
Brown	12

Table 2
Minimum Coefficient of Retroreflection
[0.2° observation angle and -4° entrance angle]

Type IX Sheeting: 7 Year Life Span	
Sheeting Color	**Candelas per Foot - Candle per Sq. Ft.**
Floresent Yellow Green	300

531.3. EQUIPMENT: Provide machinery, tools, and equipment necessary for proper execution of the work.

531.4. CONSTRUCTION: Construction shall be high quality with no visible defects in the finished product. Fabrication shall be in accordance with these specifications. Street name signs shall always be supplied and installed at each project intersection whether signs previously existed at the location or not.

A. Unsignalized Intersection. At unsignalized intersections, ground-mounted street name signs of 9 inch heights with 6 inch letters and 1-½ inch block numbers are required.

B. Signalized Intersection.

1. **Ground Mounted Street Signs.** If a signalized intersection has either mast arms or span-wire on which overhead street name signs can be attached, no ground mounted streets name signs are required at that intersection.

2. **Overhead Street Signs.** Signs shall be bolted or strapped to the mast arm or span wire. Attachments to mast arms shall be by means of a ⅝ inch stainless steel strap and a stainless steel flared strap bracket.

   a. **Signs Outside Central Business District.** Overhead street name signs installed outside of the Central Business District shall be 15 inches high with 6½ inch letters and 4½ inch block numbers.

b. **Signs Within Central Business District.** Overhead street name signs installed inside the Central Business District shall be 18 inches high with 8 inch letters and 4 ½ inch block numbers. Overhead street name signs shall be installed on all approaches.

C. **Existing Signs.** The removal of existing signs shall be coordinated with the Traffic Division to assure required signage is in place during all construction phases. When existing signs are to be removed, they will be unbolted from their post by hand and delivered to the Traffic Operations Section (207-7765).

531.5. MEASUREMENT: Measurement shall be based on the number of satisfactorily installed signs.

531.6. PAYMENT: The accepted quantities shall be paid at the contract unit price for the sign type applicable in the bid list which shall be full compensation, furnishing of all materials, labor, tools, equipment, and supplies to construct signs of varying sizes and legends as shown on the plans or as specified by the Traffic Design Engineer.

531.7. BID ITEM:

Item 531.1 - Metro Street Name, Block Numbers* (Varies x 15")

Item 531.2 - Metro Street Name, Block Numbers* (Varies x 18")

Item 531.3 - R1-1 STOP* (30")

Item 531.4 - R1-2 YIELD* (36")

Item 531.5 - R1-4 ALL WAY plate* (18" x 6")

Item 531.6 - R2-1 Speed Limit* (24" x 30")

Item 531.7 - R3-1 No Right Turn* (24" x 24")

Item 531.8 - R3-2 No Left Turn* (24" x 24")

Item 531.9 - R3-3 NO TURNS* (24" x 24")

Item 531.10 - R3-4 No U-Turns*(24" x 24")

Item 531.11 - R3-5 Left or Right Only* (30" x 36")

Item 531.12 - R3-6 Lane-Use Control* (30" x 36")

Item 531.13 - R3-7 LEFT LANE MUST TURN LEFT or RIGHT LANE MUST TURN RIGHT* (30" x 30")

Item 531.14 - R3-8 Lane-Use Control* (30" x 30")

Item 531.15 - R3-8 U-Turn Only* (24" x 30")

Item 531.16 - R3-9 Two Way Left Turn Only* (30" x 36")

Item 531.17 - R4-7 Keep Right* (24" x 30")

Item 531.18 - R5-1 DO NOT ENTER* (30" x 30")

Item 531.19 - R6-1 ONE WAY* (36" x 12")

Item 531.20 - R6-2 ONE WAY* (18" x 24")

Item 531.21 - R7-1 NO PARKING ANYTIME* (18" x 24")

Item 531.22 - R7-18 NO PARKING THIS SIDE THIS BLOCK*(18" x 24")

Item 531.23 - R1-1 (STOP)* (18" X 18")

Item 531.24 - R9-3a Pedestrian Crossing Prohibited*(18" X 18")

Item 531.25 - R10-11 NO TURN ON RED 7-9 AM AND 2-4 PM, SCHOOL DAYS ONLY*

Item 531.26 - R10-11a NO TURN ON RIGHT*(24" x 30")

Item 531.27 - R10-12 LEFT TURN YIELD ON "Green Ball"*(30" x 36")

Item 531.28 - R10-5 LEFT ON ARROW ONLY*(24" x 30")

Item 531.29 - R10-6 STOP HERE ON RED* (24" x 36")

Item 531.30 - R10-7 DO NOT BLOCK INTERSECTION*(24" x 30")

Item 531.31 - S-25 NO PARKING 7-9 AM AND2-4 PM SCHOOL DAYS ONLY*(18" x 24")

Item 531.32 - S-26 NO PARKING 7-9 AM AND2-4 PM STUDENT LOADING, SCHOOL DAYS ONLY*(18" x 24")

Item 531.33 - S-27 NO PARKING 7-9 AM AND 2-4 PM SCHOOL BUS ZONE, SCHOOL DAYS ONLY*(18" x 24")

Item 531.34 - S1-1 Advance School Crossing and School Crossing**(36" x 36")

Item 531.35 - W16-7 Diagonal Arrow sign**(30" x 18")

Item 531.36 - S4-1 1\20 MPH School Sign***(24" x 48")

Item 531.37 - W1-1 Turn*(30" x 30")

Item 531.38 - W1-2 Curve*(30" x 30")

Item 531.39 - W1-3 Reverse Turn*(30" x 30")

Item 531.40 - W1-4 Reverse Curve*(30" x 30")

Item 531.41 - W1-5 Winding Road*(30" x 30")

Item 531.42 - W1-6 Large Arrow* (48" X 24")

Item 531.43 - W1-7 Large Arrow* (48" X 24")

Item 531.44 - W16-7 Diagonal Arrow sign* (30" x 18")

Item 531.45 - W1-8 Chevron Alignment* (18" x 24")

Item 531.46 - W3-3 Signal Ahead* (36" x 36")

Item 531.47 - W8-1 BUMP* (30" x 30")

Item 531.48 - W8-2 DIP* (30" x 30")

Item 531.49 - W9-2 Lane Ends Merge Left* (30" x 30")

Item 531.50 - W10-1 Railroad Advance Warning* (36" Dia.)

Item 531.51 - W11-2 Ped Crossing* (30" x 30")

Item 531.52 - W13-1 Advisory Speed* (18" x 18")

Item 531.53 - W14-1 DEAD END* (30" x 30")

Item 531.54 - W14-2 NO OUTLET* (30" x 30")

Item 531.55 - OM-3 Type 3 Object Marker* (12" x 36")

Item 531.56 - OM-4P End of Road Marker* (18" x 18")

Item 531.57 - 9 inch Street Name, Block Numbers* (Varies x 9")

Item 531.58 - W14-1P Dead End Street Marker* (36" x 9")

Item 531.59 - Special Sign*

Item 531.60 - W14-2P No Outlet Street Marker* (36" x 9")

Item 531.61 - S5-1 School Speed Limit When Flashing*** (24" x 48")

Item 531.62 - W16-9p Ahead** (36" x 20")

Item 531.63 - W16-2 XXX FT** (30"x 18")

Item 531.64 - W13-1 30MPH Advisory** (18" x 18")

Item 531.65 - S4-3A School Zone Arrows* (24" x 18")

Item 531.66 - S5-2A, End School Zone* (24" x 9")

Item 531.67 - R9-6 (YIELD TO PEDS)* (12" X 18")

Item 531.68 - R3-17 (BIKE LANE)* (30" X 24")

Item 531.69 - R3-17a (AHEAD)* (30" X 12")

Item 531.70 - R3-17b (ENDS)* (30" X 12")

Item 531.71 - R4-4 (BEGIN RIGHT TURN LANE YIELD TO BIKES)* (36" X 30")

Item 531.72 - R1-2 (YIELD)* (18" X 18" X 18")

Item 531.73 - W11-1 (Bicycle Warning)* (30" X 30")

Item 531.74 - R5-3 (NO MOTOR VEHICLES)* (24" X 24")

Item 531.75 - D11-1 (Bike Route)* (24" X 18")

Item 531.76 - M4-11 (BEGIN)* (Bicycle Route Supplemental Plaques) (12" X 4")

Item 531.77 - M4-12 (END)* (Bicycle Route Supplemental Plaques) (12" X 4")

Item 531.78 - M4-13 (TO)* (Bicycle Route Supplemental Plaques) (12" X 4")

Item 531.79 - M7-1 (arrow)* (Route Sign Supplemental Plaques) (12" X 9")

Item 531.80 - M7-2 (arrow)* (Route Sign Supplemental Plaques) (12" X 9")

Item 531.81 - M7-3 (arrow)* (Route Sign Supplemental Plaques) (12" X 9")

Item 531.82 - M7-3 (arrow)* (Route Sign Supplemental Plaques) (12" X 9")

Item 531.83 - M7-3 (arrow)* (Route Sign Supplemental Plaques) (12" X 9")

Item 531.84 - M7-3 (arrow)* (Route Sign Supplemental Plaques) (12" X 9")

Item 531.85 - M7-3 (arrow)* (Route Sign Supplemental Plaques) (12" X 9")

* High Intensity

** Diamond Grade (Fluorescent Yellow Green)

*** Diamond Grade (Fluorescent Yellow Green) with High Intensity White Background

NOTE: All overhead mounted signs shall be Diamond Grade

ITEM

533 CLEANING AND REMOVAL OF PAVEMENT MARKINGS AND MARKERS

533.1. DESCRIPTION: *Clean both concrete and asphaltic surfaces prior to the placement of pavement markings/markers and/or for removal of existing pavement markings and raised pavement markers.*

533.2. MATERIALS: The blasting medium shall be a quality commercial product capable of producing the specified surface cleanliness without the deposition of deleterious materials on the cleaned surface.

533.3. EQUIPMENT: All equipment shall be of sufficient capacity to efficiently and economically clean the roadway surface to the specified cleanliness. Equipment shall be power driven and in good operating condition. Equipment shall utilize moisture and oil traps, in working order, of sufficient capacity to remove contaminants from the air and prevent deposition of moisture, oil or other contaminants on the roadway surface.

533.4. CONSTRUCTION: Unless otherwise shown on the plans, acceptable methods of removal for asphaltic pavements include heat scarification, blasting, and mechanical methods. Grinding is not an acceptable mechanical method unless otherwise approved by the Engineer. Blasting is the only acceptable method for removal or cleaning of a portland cement concrete surfaced pavement.

A. Removal of Existing Pavement Markings/Markers.

1. Existing markings or markers to be removed shall be removed to the extent that the pavement marking or marker and its adhesive compound is/are either completely removed or obliterated.

2. Widths, lengths, and shapes of the cleaned surface shall be of sufficient size to include the full area of the specified pavement marking to be placed or removed.

3. Avoid damage to the pavement surface during the removal of markings or markers. Repair damaged areas on asphaltic surfaces in excess of ¼ inch in depth using approved patching materials.

4. Blasting on portland cement concrete surfaces shall be sufficient to remove old pavement markings and all other contaminants. Over-blasting to the extent of damage to the roadway surface shall be avoided.

5. Very small particles of tightly adhering existing markings may remain in place if complete removal of the small particles will result in pavement damage.

B. Cleaning.

1. Pavement surfaces where existing pavement markings will remain in place shall be cleaned with high pressure air or water to remove dust, sand, and other objectionable material prior to application of new markings. If water is used, the area to be cleaned shall be sufficiently dry, as defined in Item 535.4.A.1, for application of the marking material.

2. All surfaces other than portland cement concrete surfaces required to be cleaned shall be cleaned sufficiently to remove loose and flaking conditions or markings of the road surface. Surface cleaning shall be completed on all existing pavements where the inlaid plastic material or raised pavement marker is not being used with new pavement.

3. Where blasting is used for the removal of pavement markings, adhesives, or for removal of objectionable material, remove the residue, including dust and water, immediately after contact with the surface being treated. Remove by a vacuum attachment operating concurrently with the blasting operation.

4. Where grinding is allowed by the Engineer to remove pavement markings on asphaltic concrete pavements, remove the residue by means of a vacuum attachment to the grinding machine. Do not allow the residue to flow across or be left on the pavement.

533.5. MEASUREMENT AND PAYMENT: Cleaning or removal of existing or incorrectly installed pavement markings and/or markers shall not be paid for directly, but shall be considered subsidiary to the pavement marking or marker items or Mobilization if no pavement marking pay items are used.

533.6. BID ITEM: This specification is included solely as a technical guide as to how cleaning or removal of markings and/or markers shall be performed and does not constitute a separate bid item.

ITEM

535 HOT APPLIED THERMOPLASTIC PAVEMENT MARKINGS

535.1. DESCRIPTION: *Apply thermoplastic pavement markings, in conformance with the minimum optical and physical properties required for a thermoplastic road marking compound described herein, in a molten state, onto a pavement surface.*

535.2. MATERIALS: All materials shall conform to the requirements of TxDOT DMS-8220 "Hot Applied Thermoplastic." Thermoplastic materials shall be stored in a dry environment to minimize the amount of moisture retained during storage.

535.3. EQUIPMENT: Provide the necessary equipment to conduct the work specified herein. All equipment shall be maintained in good working order such that neat and clean thermoplastic markings are applied at the proper thicknesses and glass beads are placed at the correct rate. Equipment that is deemed deficient by the Engineer shall be replaced immediately.

535.4. CONSTRUCTION: The appearance of the finished markings shall have a uniform surface, crisp edges with a minimum over-spray, clean cut-off, meet straightness requirements and conform to the design drawings and/or engineer instructions.

The contractor shall provide the Engineer with certification from the marking manufacturer that contractor has been adequately trained and certified to apply the manufacturer's material. This certification shall be considered current if the certification date provided by the manufacturer is within two years of the date of marking application.

All striping and pavement markings shall be placed in accordance with the requirements of this specification, the detailed plans, and the current edition of the *Texas Manual on Uniform Traffic Control Devices* (TMUTCD). The Contractor shall provide all other engineering services necessary for pre-marking of all proposed stripe within the limits of the designated work.

Unless authorized otherwise in writing by the Engineer, striping shall be accomplished during daylight hours. Approved lighting arrangements will be required for night time operations when allowed.

The Contractor may be required to place markings over existing markings, as determined by the Engineer. The contractor shall adjust the operation of the thermoplastic screed shoe to match the previous lengths of stripes and skips, when necessary.

Failure of the striping material to adhere to the pavement surface during the life of the contract shall be prima facie evidence that the materials, even though complying with these specifications, or the application thereof, was inconsistent with the intent of the requirements for the work under the latest City specifications and shall be cause for ordering corrective action or replacement of the marking without additional cost to the City.

Unless otherwise approved by the Engineer, permanent pavement markings on newly constructed pavements surfaced with asphaltic concrete or bituminous seals shall not be applied for a minimum of 14 days or a maximum 35 days. Temporary pavement marking shall be provided during the 14 to 35 day period.

A. Surface Preparation.

1. **Moisture.** All surfaces shall be inspected for moisture content prior to application of thermoplastic. Approximately two square feet of a clear plastic or tar paper shall be laid on the road surface and held in place for 15 to 20 minutes. The underside of the plastic or tar paper shall then be inspected for a buildup of condensed moisture from the road surface. Pavement is considered dry if there is no condensation on the underside of the plastic or tarpaper. In the event of moisture, this test shall be repeated until there is no moisture on the underside of the plastic or tar paper.

2. **Cleaning.** All surfaces shall be clean and dry, as defined in Section 535.4.A.1, before thermoplastic can be applied. Loose dirt and debris shall be removed by thoroughly blowing compressed air over the area to be striped. If the thermoplastic is to be applied over existing paint lines, the paint line shall be swept with a mechanical sweeper or wire brush to remove poorly adhered paint and dirt that would interfere with the proper bonding or the thermoplastic. Additional cleaning through the use of compressed air may be required to remove embedded dirt and debris after sweeping. Latence and curing compound shall be removed from all new portland cement concrete surfaces in accordance with Item 533, "Removal of Pavement Markings and Markers."

3. **Layout.** The pavement markings shall be placed in proper alignment with guidelines established on the roadway. Deviation from the alignment established shall not exceed 2 inches and, in addition, the deviation in alignment of the marking being placed shall not exceed 1 inch per 200 feet of roadway nor shall any deviation be abrupt.

   No striping material shall be applied over a guide cord; only longitudinal joints, existing stripes, primer, or other approved type guides will be permitted. In the absence of a longitudinal joint or existing stripe, the Contractor shall mark the points necessary for the placing of the proposed stripe. Edge striping shall be adjusted as necessary so that the edge stripe will be parallel to the centerline and shall not be placed off the edge of the pavement.

   Longitudinal markings shall be offset at least 2-inches from construction joints of portland cement concrete surfaces and joints and shoulder breaks of asphalt surfaces.

4. **Primer Sealer.** Primer sealer shall be used on all portland cement concrete surfaces. A primer sealer shall be used on asphalt surfaces that are over two years old and/or on asphalt surfaces that are worn or oxidized to a condition where 50 percent or more of the wearing surface is exposed aggregate. Existing pavement markings may act as the primer sealer if, after cleaning, more than 70 percent of the existing pavement marking is still properly bonded to the asphalt surface (see coverage check procedure in Appendix A to estimate percent of marking remaining).

5. **Primer Sealer Application.** When required as described, the primer-sealer shall be applied to the road surface in a continuous film at a minimum thickness of 3 to 5 mils. Before the Thermoplastic is applied, the primer-sealer shall be allowed to dry to a tacky state. The thermoplastic shall be applied within 4 hours after the primer application.

B. Temperature Requirements.

1. **Ambient Conditions.** The ambient air and road surface shall be 55°F and rising before application of thermoplastic can begin.

2. **Material Requirements.** Unless otherwise specified by the material manufacturer, the thermoplastic compound shall be heated from 400°F to 450°F and shall be a minimum of 400°F as it makes contact with road surface during application. An infrared temperature gun shall be used to determine the temperature of the thermoplastic as it is being applied to the road surface.

C. Drop-on Glass Sphere Application.

1. **Application Rate.** Retro-reflective glass spheres shall be applied at the rate of 10 pounds per 100 square feet of applied markings. This application rate shall be determined by confirming the following consumption rates:

   a. 200 pounds of drop on glass spheres per ton of applied thermoplastic when the thermoplastic is being applied at 0.090 inch film thickness.

   b. 150 pounds of drop on glass spheres per ton of applied thermoplastic when the thermoplastic is being applied at 0.125 inch thickness.

2. **Application Method.** Retro-reflective glass spheres shall be applied by a mechanical dispenser property calibrated and adjusted to provide proper application rates and uniform distribution of the spheres across the cross section of the entire width of the line. To enable the spheres to embed themselves into the hot thermoplastic, the sphere dispenser shall be positioned immediately behind the thermoplastic application device. This insures that the spheres are applied to the thermoplastic material while it is still in the molten state.

D. Application Thickness.

1. **Longitudinal and Transverse Markings.** On previously unmarked pavements or pavements where markings have been effectively removed, all lane lines, center lines, transverse markings and pavement markings in traffic areas with ≤1,000 vehicles per day per lane shall have a minimum film thickness of 0.090 inch at the edges and a maximum of 0.145 inch at the center. A minimum average film thickness of 0.090 inch shall be maintained. On pavements with existing markings, meeting the traffic requirements stated above, all lane lines, center lines, transverse markings and pavement markings shall have a minimum film thickness of 0.060 inch for re-application over existing strip line.

2. **High Wear Longitudinal and Transverse Marking.** On previously unmarked pavements or pavements where markings have been effectively removed, all lane lines, center lines, transverse markings and pavement markings in high traffic areas (>1,000 vehicles per day per lane) shall have a minimum film thickness of 0.125 inch at the edges and a maximum of 0.188 inch at the center. A minimum average film thickness of 0.125 inch shall be maintained. On pavements with existing markings, meeting the traffic requirements stated above, all lane lines, center lines, transverse markings and pavement markings shall have a minimum film thickness of 0.090 inch for re-application over existing strip line.

E. Packaging.

1. **Containers.** The thermoplastic material shall be delivered in 50 pound containers or bags of sufficient strength to permit normal handling during shipment and handling on the job without loss of material.

2. **Labeling.** Each container shall be clearly marked to indicate the color of the material, the process batch number and/or manufacturer's formulation number, the manufacturer's name and address and the date of manufacture.

F. Acceptance.

1. **Sampling Procedure.** Random samples may be taken at the job site at the discretion of the City Engineer for quality assurance. The City reserves the right to conduct the tests deemed necessary to identify component materials and verify results of specific tests indicated in conjunction with the specification requirements.

   The sample(s) shall be labeled as to the shipment number, lot number, date, quantity, and any other pertinent information. At least three randomly selected bags shall be obtained from each lot. A 10 pound) sample from the three bags shall be submitted for testing and acceptance. The lot size shall be approximately 44,000 pounds unless the total order is less than this amount.

2. **Manufacturer's Responsibility.**

   a. **Sampling and Testing.** The manufacturer shall submit test results from an approved independent laboratory. All material samples shall be obtained 20 days in advance of the pavement marking operations. The cost of testing shall be included in the price of thermoplastic material. The approved independent laboratory's test results shall be submitted to the City Traffic Engineer in the form of a certified test report.

   b. **Bill of Lading.** The manufacturer shall furnish the Material and Tests Laboratory with copies of Bills of Lading for all materials inspected. Bill of lading shall indicate the consignee and the destination, date of shipment, lot numbers, quantity, type of material, and location of source.

   c. **Material Acceptance.** Final acceptance of a particular lot of thermoplastic will be based on the following.

      (1) Compliance with the specification for material composition requirements verified by approved independent laboratory with tests results.

      (2) Compliance with the specification for the physical properties required and verified by an approved independent laboratory with test results.

      (3) Manufacturer's test results for each lot thermoplastic have been received.

      (4) Identification requirements are satisfactory.

3. **Contractor's Responsibility.**

   a. **Notification.** The contractor shall notify the Construction Inspector 72 hours prior to the placement of the thermoplastic markings to enable the inspector to be present during the application operation. At the time of notification, the Contractor shall indicate the manufacturer and the lot numbers of the thermoplastic that will be used.

A check should be made by the contractor to insure that the approved lot numbers appear on the material package. Failure to do so is cause for rejection.

b. **Warranty or Guarantee.** If the normal trade practice for manufacturers is to furnish warranties or guarantees for the materials and equipment specified herein, the Contractor shall turn the guarantees and warranties over to the Engineer for potential dealing with the manufactures. The extent of such warranties or guarantees will not be a factor in selecting the successful bidder.

535.5. **MEASUREMENT:** Measurement shall be based on the length of satisfactorily installed line, in feet, or as appropriate, the number of symbols or words which are satisfactorily installed on the roadway surface by the contractor.

535.6. **PAYMENT:** Payment shall be according to the quantities measured for each bid item.

535.7. **BID ITEM:**

Item 535.1 - 4 inch wide yellow line

Item 535.2 - 4 inch wide white line

Item 535.3 - 8 inch wide yellow line

Item 535.4 - 8 inch wide white line

Item 535.5 - 12 inch wide white line

Item 535.6 - 16 inch wide white line

Item 535.7 - 24 inch wide white line

Item 535.8 - Right White Arrow (per each)

Item 535.9 - Left White Arrow (per each)

Item 535.10 - Combination Thru/Right White Arrow (per each)

Item 535.11 - Combination Thru/Left White Arrow (per each)

Item 535.12 - Word "ONLY" (per word)

Item 535.13 - Straight White Arrow (per each)

Item 535.14 - Railroad Crossing Symbol, including two R's, crossbuck and 3 transverse bars (per each)

Item 535.15 - White Diamond (per each)

Item 535.16 - Straight White Arrow Bicycle Facility (per each)

Item 535.17 - Bicycle Rider Symbol (per each)

Item 535.18 - Solid White Yield Lines (6" x 9") (per each)

Item 535.19 - Word "STOP" (per word)

Item 535.20 - Word "YIELD" (per word)

Item 535.21 - Word "BUS) (per word)

APPENDIX A: Method for Estimating Amount of Marking Bonded to Pavement

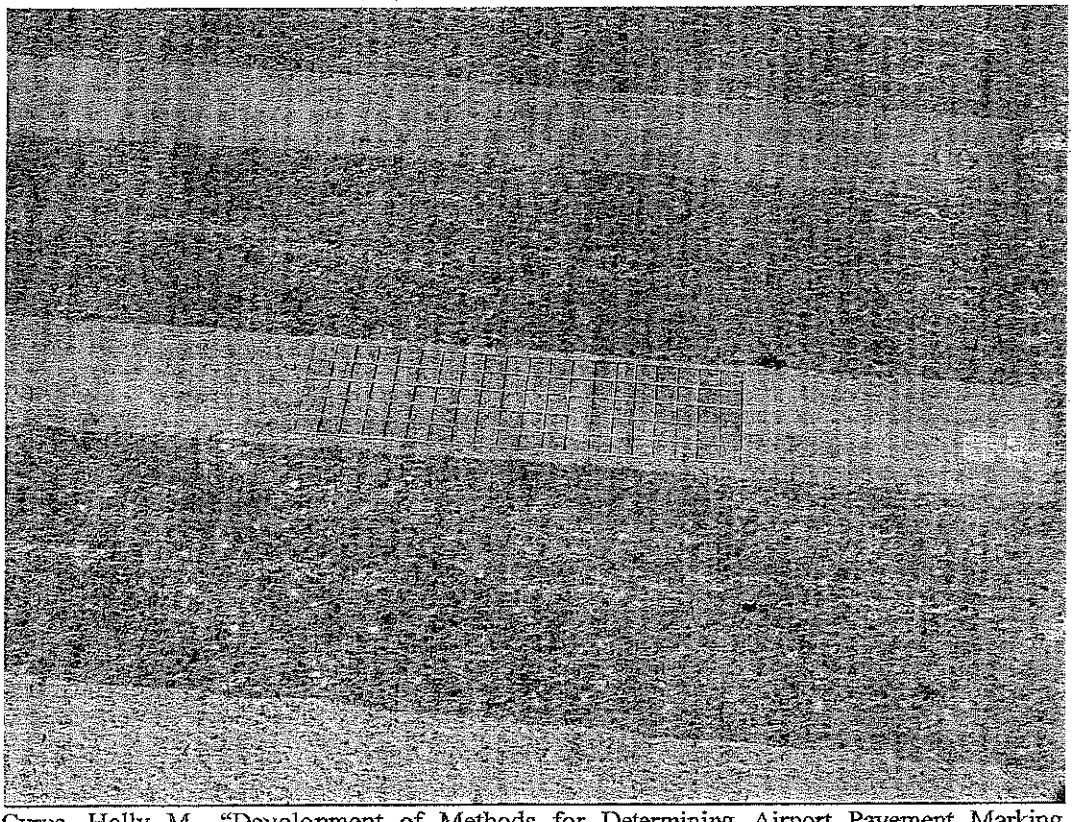
This inspection will ensure uniformity of coverage of the entire line, such as paint cracking, peeling, and whether or not the marking has adequate coverage. One-square-inch sections of transparent material inscribed within a grid of 100 equal squares shall be used as a tool for quantitative measure of specified percentage of coverage. The grid concept was taken from the Air Force who used it for measuring rubber coverage on pavement. For a 4-inch line, it is suggested that a grid of 4 x 25 inches be used, and for a 12-inch (or larger) line, a grid of 10 x 10 inches. Count the squares that have no paint, e.g., 3 out of 100 squares equal 3% of the paint gone or 97% coverage.

Follow the steps below to take the readings of the pavement markings:

1. Using either the 10- x 10-inch grid or the 4- x 25-inch grid, place the grid on the line to be evaluated.

2. Count the squares that have no paint.

3. The number of squares without paint will be the percentage of paint gone. In other words, if there are 30 out of 100 squares that have no paint, then 30% of the paint is gone.



Cyrus, Holly M., "Development of Methods for Determining Airport Pavement Marking Effectiveness," DOT/FAA/AR-TN03/22, Federal Aviation Administration, March 2003.

ITEM

536 PREFORMED PAVEMENT MARKINGS

536.1. DESCRIPTION: *Provide a long-term tape and sheeting pavement marking material to be used for permanent type longitudinal or transverse lines and word/symbol legends.*

536.2. MATERIALS: All materials shall conform to the requirements of TxDOT DMS-8240 "Permanent Prefabricated Pavement Markings" as shown on the plans. Type A, B, or C prefabricated markings shall be indicated on the plans based upon the traffic conditions of the roadway and the placement method indicated.

536.3. EQUIPMENT: Provide the necessary equipment to conduct the work specified herein.

536.4. CONSTRUCTION: All markings shall be located as shown in the plans.

The contractor shall install the preformed plastic pavement markings to newly paved hot-mix asphaltic concrete pavements by the in-laid method unless the temperature of the pavement has reached or fallen below the minimum allowable pavement temperature shown in Table 1.

Table 1
Acceptable Pavement Temperatures for Application of Pavement Markings.

Hot Mix Asphalt Mixture Type Upon Which the Preformed Pavement Marking is to be Applied	Surface Temperature Range for Inlaid Method, °F	Minimum Allowable Pavement Temperature for Inlaid Method, °F	Surface Temperature Range for Cold-Laid Method, °F
Open-Graded Friction Course (OGFC)	160 °F to 180 °F	160 °F	60 °F to 120 °F
Stone Matrix Asphalt (SMA)			
Dense Graded Hot Mixed Asphalt w/PG 76- or 82-XX Asphalt Cement			
Dense Graded Hot Mixed Asphalt w/PG 70-, 64-, or 58-XX Asphalt Cement	120 °F to 155 °F	120 °F	

All material shall be placed according to the manufacturer's instructions, and in accordance with the surface condition, moisture and temperature requirements listed below:

A. Inlaid Preformed Pavement Markings.

This installation procedure shall apply to streets with newly paved asphaltic concrete surfaces that have attained the temperature ranges shown in Table 1 from initial placement. If at any time after initial placement the pavement cools to below the minimum allowable temperature as shown in Table 1, the markings shall be installed as Hot Applied Thermoplastic Pavement Marking per Item 535 requirements. For portland cement concrete streets, see Cold-Laid Preformed Pavement Markings (next section) below.

The contractor shall place and inlay all pavement markings on the newly placed asphaltic concrete pavement prior to the final rolling of the asphalt.

The preformed pavement markings shall be applied after the newly placed asphaltic concrete pavement has been adequately compacted and within the temperature range specified in Table 1. The Contractor will be required to install temporary pavement markings at no additional cost to the City if the cold-laid method is used. Preformed pavement line markings shall be installed with a mechanical applicator which shall be capable of placing pavement lines in a neat, accurate and uniform manner. The mechanical applicator shall be equipped with a film cut-off device. Word legends and arrows shall be installed by hand and result in neat, accurate and uniform words and arrows.

The preformed pavement markings shall be inlaid into the asphaltic concrete surface by means of a mechanical roller. The roller shall be of sufficient weight capacity to inlay the pavement marking to a minimum depth of 65% of the material thickness, and to not more than 80% of the material thickness while the temperature range of the pavement surface is within the ranges specified in Table 1. In the event the inlaid markings are distorted or discolored to the point that cleaning does not restore its initial appearance by the contractor's operations, fail to provide a uniform appearance, or are installed improperly, such markings shall be removed and replaced in the finished surface of the pavement as Hot Applied Thermoplastic Pavement Marking per Item 535 requirements at no additional expense to the City.

B. Cold-Laid Preformed Pavement Markings.

This installation procedure applies to all portland cement concrete pavements, existing asphaltic concrete pavement, and newly placed asphaltic concrete that at any time has fallen below the minimum allowable temperature specified in Table 1 after initial placement.

Pavement on which pavement markings are to be placed shall be cleaned and prepared prior to placement of markings. Cleaning shall be in conformance with Item 533, "Cleaning and Removal of Pavement Markings and Markers" such that contaminants, loose materials, and conditions deleterious to proper adhesion are removed. When blast cleaning is required, it shall be done to the extent that a sound pavement surface is exposed. Surfaces shall be further prepared after cleaning by sealing or priming, as recommended by the manufacturer.

Pavement to which materials to be applied shall be completely dry. Materials shall not be applied until concrete pavement has appeared to be dry for a minimum of four hours and until asphaltic concrete pavement has appeared to be dry for a minimum of two hours.

Pavement and ambient air temperature requirements recommended by the manufacturer shall be observed. If no temperature requirements are established by the manufacturer, material shall not be placed if the surface temperature is outside the acceptable range shown in Table 1 (see column 4 of this table).

536.5. MEASUREMENT: Measurement shall be made by the length of satisfactorily installed line, in feet, the number of and types of symbols and other pavement legends in accordance with the plans and specifications.

536.6. PAYMENT: The accepted quantities shall be paid at the contract unit price for the type of line or legend applicable in the bid list which shall be full compensation for materials, surface preparation, labor and incidentals.

536.7. BID ITEM:

Item 536.1 - 4 inch Wide Yellow Line

Item 536.2 - 4 inch Wide White Line

Item 536.3 - 8 inch Wide Yellow Line

Item 536.4 - 8 inch Wide White Line

Item 536.5 - 12 inch Wide White Line

Item 536.6 - 16 inch Wide White Line

Item 536.7 - 24 inch Wide White Line

Item 536.8 - Right White Arrow (per each)

Item 536.9 - Left White Arrow (per each)

Item 536.10 - Combination Thru/Right White Arrow (per each)

Item 536.11 - Combination Thru/Left White Arrow (per each)

Item 536.12 - Word "ONLY" (per word)

Item 536.13 - Straight White Arrow (per each)

Item 536.14 - Railroad Crossing Symbol, including two R's, crossbuck and 3 transverse bars (per each)

Item 536.15 - White Diamond (per each)

Item 536.16 - Straight White Arrow Bicycle Facility (per each)

Item 536.17 - Solid White Yield Lines (6" x 9") per each)

Item 536.18 - Word "STOP" (per word)

Item 536.19 - Word "YIELD" (per word)

Item 536.20 - Word "BUS" (per word)

ITEM

537 RAISED PAVEMENT MARKERS

537.1. **DESCRIPTION:** *Provide raised pavement markers which include reflectorized and non-reflectorized traffic buttons, pavement markers and jiggle bars all of which are capable of being attached to a roadway surface by an adhesive.*

537.2. **MATERIALS:** Materials shall conform to the following requirements:

A. Jiggle Bar Tiles. TxDOT DMS-4100, "Jiggle Bar Tiles."

B. Raised Pavement Markers. TxDOT DMS-4200, "Pavement Markers (Reflectorized)."

C. Traffic Buttons. TxDOT DMS-4300, "Traffic Buttons."

D. Testing. The Engineer reserves the right to perform any or all tests required by this item as a check on the tests reported by the manufacturer. Upon request, the Contractor shall furnish, free of charge, samples of the material of the size and in the amount determined by the Engineer for test purposes. In case of any variance, the Engineer's tests will govern.

537.3. **EQUIPMENT:** Provide all equipment necessary to perform the work specified herein.

537.4. **CONSTRUCTION:** The Contractor shall establish guides to mark the lateral location of pavement markings as shown on the plans or as directed by the Engineer. The Engineer shall approve locations of these markings and may authorize necessary adjustments from the plans.

The reflective faces of all Type II markers shall be positioned so that the direction of reflection of one (1) face shall be directly opposite to the direction of reflection of the other face.

Raised Pavement markers Type I-C shall have clear reflector face towards traffic. Raised pavement markers Type II C-R, shall have the clear face toward the normal traffic flow and the red face toward wrong-way traffic.

Unless otherwise shown on the plans or specified by the Engineer, all raised pavement markers placed in broken lines shall be placed in line with and midway between the stripes. The first and last raised pavement marker in a no-passing line shall be a reflective marker. Buttons used to simulate a 10 feet skip lane lines shall be spaced at 40 inches.

The pavement markers not placed in accordance with the plans or as directed by the Engineer shall be removed by the Contractor at the Contractor's expense.

Removal of existing pavement markers or residual adhesive from a missing pavement marker prior to placement of new or replacement marker(s) shall be in conformance with Item 533, "Cleaning or Removal of Pavement Markings or Markers." The portion of the highway surface to which the raised pavement marker is attached by the adhesive shall be clean and free of dirt, grease, oil, and moisture at the time of installation. Surface preparation for installation of raised pavement markers will not be paid for directly, but shall be considered subsidiary to this item. Unsound pavement or other materials that would adversely affect the bond of the adhesive shall not be an acceptable surface.

The hot epoxy adhesive shall be applied so that 100 percent of the bonding area of the raised pavement marker will be in contact and shall be of sufficient thickness so that excess adhesive shall be forced out around the perimeter of the raised pavement marker but without impairing the functional capability of the reflectivity of the pavement marker. When the project is complete, the raised pavement marker shall be firmly bonded to the pavement; lines formed by the raised pavement markers shall be true, and the entire installation shall present a neat appearance.

Where required by the Engineer, pavement markings outside the limits of this project will be removed or adjusted to provide for a proper tie into this project. The old markings shall be removed or defaced in such a manner that they do not give the appearance of traffic pavement markings.

537.5. MEASUREMENT: Measurement will be based on the number of satisfactorily installed pavement markers.

537.6. PAYMENT: Pavement markers will be paid for at the contract unit bid price per each type of marker. The price shall be full compensation for furnishing the raised pavement marker, epoxy adhesive and all other materials, surface preparation, installation, labor, equipment, tools and incidentals necessary to complete the work.

537.7. BID ITEM:

Item 537.1 - Traffic Button (Type W) per each

Item 537.2 - Traffic Button (Type Y) per each

Item 537.3 - Jiggle Bar (Type W) per each

Item 537.4 - Jiggle Bar (Type Y) per each

Item 537.5 - Pavement Marker (Type I-A) per each

Item 537.6 - Pavement Marker (Type I-C) per each

Item 537.7 - Pavement Marker (Type I-R) per each

Item 537.8 - Pavement Marker (Type II-A-A) per each

Item 537.9 - Pavement Marker (Type II C-R) per each

ITEM

540 TEMPORARY EROSION, SEDIMENTATION AND WATER POLLUTION PREVENTION AND CONTROL

540.1. DESCRIPTION: *This item shall govern the control measures necessary to prevent and control soil erosion, sedimentation and water pollution which may degrade receiving waters including rivers, streams, lakes, reservoirs, tidal water, groundwater and wetlands.*

Note: The control measures contained herein shall be installed and maintained throughout the construction contract and coordinated with the permanent or existing temporary pollution control features specified elsewhere on the plans and in the specifications to assure effective and continuous water pollution control throughout the construction and post construction period. These control measures shall not be used as a substitute for the permanent pollution control measures unless otherwise directed by the Engineer in writing. The controls may include sediment control fences, inlet protection, baled hay, rock filter dams, dikes, swales, sediment traps and basins, pipe slope drains, paved flumes, construction exits, temporary seeding, sodding, mulching, soil retention blankets or other structural or non-structural water pollution controls. This item does not apply to commercial operations.

540.2. MATERIALS: The items, estimated quantities and locations of the control measures are shown on the plans; however, the Engineer may increase or decrease the quantity of these items as the need arises. The materials will be shown on the plans and in this specification. The Engineer may allow other materials and work as the need arises and as approved in writing. Pollution control measures may be applicable to contractor operations outside the right of way where such work is necessary as a result of roadway related construction such as construction and haul roads, field offices, equipment and supply areas, and materials sources.

Unless otherwise shown on the plans, provide materials that meet the following requirements:

A. Rock Filter Dams.

1. **Aggregate.** Furnish aggregate with hardness, durability, cleanliness, and resistance to crumbling, flaking, and eroding acceptable to the Engineer. Provide the following:

   - **Types 1, 2, and 4 Rock Filter Dams.** Use 3 to 6 in. aggregate.
   - **Type 3 Rock Filter Dams.** Use 4 to 8 in. aggregate.

2. **Wire.** Provide minimum 20 gauge galvanized wire for the steel wire mesh and tie wires for Types 2 and 3 rock filter dams. Type 4 dams require:

   - a double-twisted, hexagonal weave with a nominal mesh opening of 2½ in. x 3¼ in.;
   - minimum 0.0866 in. steel wire for netting;
   - minimum 0.1063 in. steel wire for selvages and corners; and
   - minimum 0.0866 in. for binding or tie wire.

3. **Sandbag Material.** Furnish sandbags meeting Section 540.2.I, "Sandbags," except that any gradation of aggregate may be used to fill the sandbags.

B. **Temporary Pipe Slope Drains.** Provide corrugated metal pipe, polyvinyl chloride (PVC) pipe, flexible tubing, watertight connection bands, grommet materials, prefabricated fittings, and flared entrance sections that conform to the plans. Recycled and other materials meeting these requirements are allowed if approved. Furnish concrete in accordance with Item 505, "Concrete Riprap."

C. **Baled Hay.** Provide hay bales weighing at least 50 lb., composed entirely of vegetable matter, measuring 30 in. or longer, and bound with wire, nylon, or polypropylene string.

D. **Temporary Paved Flumes.** Furnish asphalt concrete, hydraulic cement concrete, or other comparable non-erodible material that conforms to the plans. Provide rock or rubble with a minimum diameter of 6 in. and a maximum volume of ½ cu. ft. for the construction of energy dissipaters.

E. **Construction Exits.** Provide materials that meet the details shown on the plans and this Section.

1. **Rock Construction Exit.** Provide crushed aggregate for long and short-term construction exits. Furnish aggregates that are clean, hard, durable, and free from adherent coatings such as salt, alkali, dirt, clay, loam, shale, soft, or flaky materials and organic and injurious matter. Use 4- to 8- in. rock for Type 1 and 2- to 4- in. rock for Type 3. Unless otherwise shown on the plans, provide a light weight (4 oz.) non-woven filter fabric below the ballast to prevent mud and sediment migration.

2. **Timber Construction Exit.** Furnish No. 2 quality or better railroad ties and timbers for long-term construction exits, free of large and loose knots and treated to control rot. Fasten timbers with nuts and bolts or lag bolts, of at least ½ in. diameter, unless otherwise shown on the plans or allowed. For short-term exits, provide plywood or pressed wafer board at least ½ in. thick.

3. **Foundation Course.** Provide a foundation course consisting of flexible base, bituminous concrete, hydraulic cement concrete, or other materials as shown on the plans or directed.

F. **Embankment for Erosion Control.** Provide rock, loam, clay, topsoil, or other earth materials that will form a stable embankment to meet the intended use.

G. **Pipe.** Provide pipe outlet material in accordance with TxDOT Standard Specification Item 556, "Pipe Underdrains," and details shown on the plans.

H. **Construction Perimeter Fence.**

1. **Posts.** Provide essentially straight wood or steel posts that are at least 60 in. long. Furnish soft wood posts with a minimum diameter of 3 in. or use 2 x 4 boards. Furnish hardwood posts with a minimum cross-section of 1½ x 1-1/5 in. Furnish T- or L-shaped steel posts with a minimum weight of 0.95 lb. per foot.

2. **Fence.** Provide orange construction fencing as approved by the Engineer.

3. **Fence Wire.** Provide 14 gauge or larger galvanized smooth or twisted wire. Provide16 gauge or larger tie wire.

ITEM

1000 WEB PORTAL

1000.1. DESCRIPTION: *This item shall govern the creation, maintenance, and delivery of projects on the Web Portal.*

1000.2. WEB PORTAL: City utilizes a Web Portal Program Management tool for all major construction projects. Contractor will be required to access and utilize this system as part of the project. Contractor will be required to have an email account and access to a computer with internet access and Citrix Client software loaded. City provides a Citrix Client software download for Windows 32 bit Operating System (Windows 2000, XP, 2003, or Vista) running Internet Explorer 6 or Internet Explorer 7. Contractor will be required to obtain a Web Portal user account from the City. Contractor will be responsible for utilizing the Web Portal to process Change Order, Requests For Information, Invoices, Submittals and other related documents through the portal. City will assist Contractor with system and provide procedures and processes on the Web Portal.

1000.3. MEASUREMENT and PAYMENT: Use of the Web Portal will not be measured or paid for directly, but shall be included in the unit price bid for the items of construction in which the operations occur.

1000.4. BID ITEM:

N/A

TRAFFIC NOTES

TRENCHING/EXCAVATING

The following notes shall apply to excavations of trenches or pits that are located in the pavement or are within six (6) feet of the edge of roadway:

1.) Trench walls shall not be closer than three (3) feet from the edge of the traveled way at any stage of construction.

2.) Traffic control devices shall be in place before starting any excavation.

3.) Trenches or pits will not be permitted to be bridged by steel plates and open to traffic unless they are temporarily backfilled to finished street grade.

4.) For pits or trenches along or in a roadway that are going to be left open over night that are zero to fifty (0 - 50) feet in length, the following applies. <u>GUARD RAIL OR CONCRETE BARRIER SHALL BE USED.</u>

5.) For pits or trenches along or in roadway that are going to be left open over night and are longer than 50 feet in length, <u>CONCRETE BARRIERS MUST BE USED.</u>

6.) Plastic construction fencing shall be required for any trench or pit left open over night.

7.) When using any guardrail or concrete barrier, protected end must be used as per the TEXAS-M.U.T.C.D.

8.) For vertical drop-offs greater than two (2) feet along roadway, low profile concrete with appropriate end protection must be installed.

9.) All concrete barriers placed on City R.O.W shall be low profile. No high profile barriers will be allowed.

REFLECTIVE SHEETING

The reflectorized white and reflectorized orange stripes for channelizing devices such as barricade drums and vertical panels shall be constructed of reflective sheeting meeting the color and retro-reflectivity requirements of high intensity, unless otherwise specified in the plans.

MAINTENANCE

1.) All traffic signs shall be kept in proper position, clean and legible at all times. Damaged barricades, signs, and other traffic control devices shall be replaced without undue delay.

2.) To ensure adequate maintenance, a suitable schedule for inspection, cleaning, and replacement of barricades, lights, and signs shall be established.

3.) Special attention and necessary action shall be taken to see that weeds, trees, shrubbery and construction materials do not obscure the face of any sign or barricades.

TRAINING

Each person whose actions affect maintenance and construction zone safety, from the upper-level management personnel through construction and maintenance field personnel, should receive training appropriate to the job decision each individual is required to make. Only those individuals who are qualified by means of adequate training in safe traffic control practices and have a basic understanding of the principles established by applicable standards and regulations, including those of the TEXAS M.U.T.C.D. should supervise the selection, placement, and maintenance of traffic control devices in maintenance and construction areas.

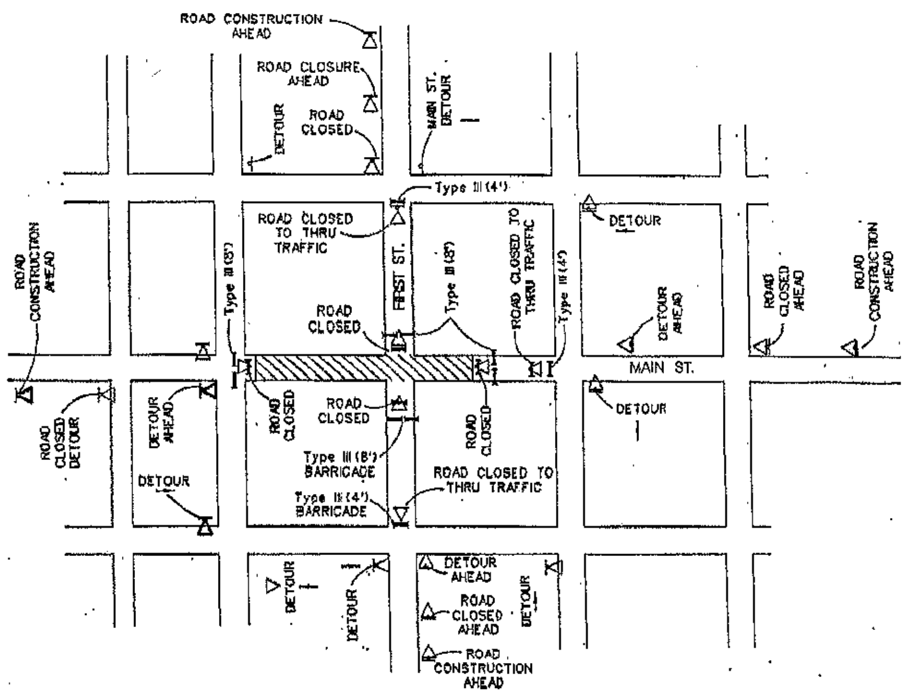
SPECIAL EVENTS BARRICADING

All Type I, (8') barricades used for special events (Dome, Runs, Walks, Parades etc.) shall be a minimum of 42" high and 96" wide. Any necessary signs will require proper sign stands.

USE OF CITY R.O.W.

The City of San Antonio reserves the right to allow contracting and barricading sub-contractors to use the City's R.O.W. The City also reserves the right to advise contractors and barricading sub-contractors to remove stored or unused traffic control devices from the City of San Antonio R.O.W. It is the barricading sub-contractor's responsibility to remove any traffic control device from City's R.O.W. when instructed to do so by a City representative.

CLOSURE DIAGRAMS



TYPICAL INTERSECTING STREET CLOSURE
FOR TWO LANE STREETS

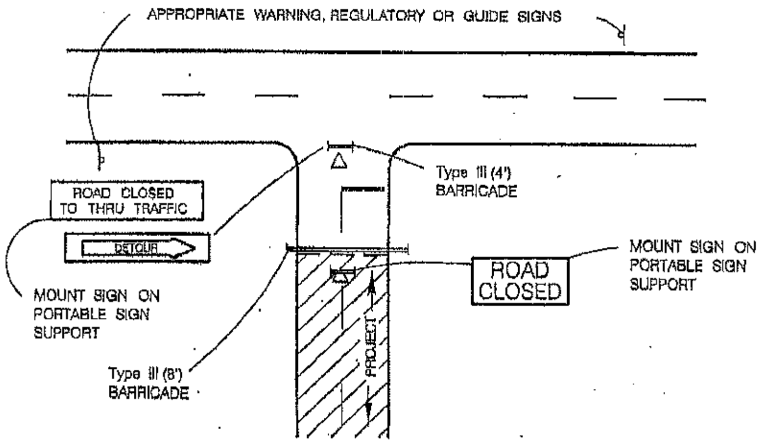
NOTE:
ALL SIGNS WILL BE
MOUNTED ON SIGN
SUPPORTS ONLY

NO.	REVISION	BY:	DATE:
2	CHANGE "DETAILS" TO "STANDARDS" IN TITLE	JDF	07.20.05
1	UPDATE DETAIL SHEET DESIGNATION	JDF	06.20.05

CITY OF SAN ANTONIO
TRAFFIC ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS

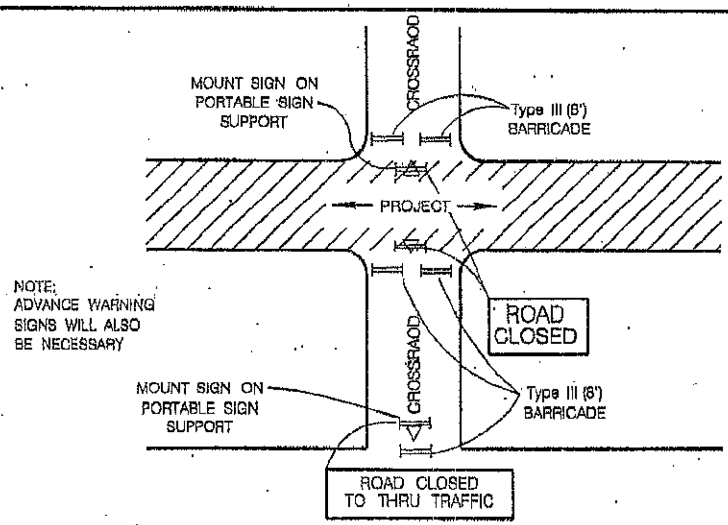
TRAFFIC STANDARDS
BARRICADE AND CONSTRUCTION STANDARDS
TE-BC(1)-05

DESIGNED: EMM	CHECKED: JDF		SHT. NO.
DRAWN: AFG	CHECKED: EMM		1 of 4
REVISED: AFG	CHECKED: JDF	SCALE:	NOT TO SCALE



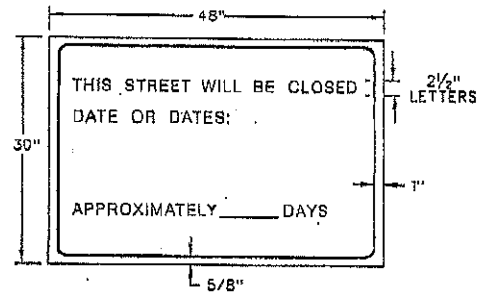
PROJECT LIMITS FOR CLOSED ROADWAY

BARRICADES SHALL BE ERECTED COMPLETELY ACROSS ROADWAY. CHANNELIZING DEVICES MAY BE DRUMS, VERTICAL PANELS OR CONES AS SPECIFIED IN THE PLANS

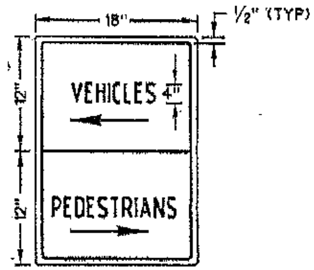


NOTE:
ADVANCE WARNING
SIGNS WILL ALSO
BE NECESSARY

CROSS STREET SIGNING AND BARRICADING
TOTALLY CLOSED

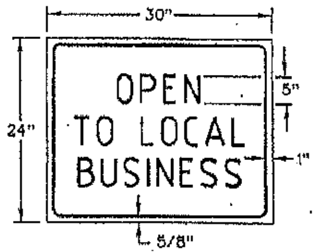


LETTERS- BLACK
BORDER- BLACK
BACKGROUND- ORANGE



LETTERS- BLACK
BORDER- BLACK
BACKGROUND- ORANGE
SPACING-3 SIGNS PER BLOCK

DIRECTION OF ARROWS
ARE REVERSABLE



LETTERS- WHITE
BORDER- WHITE
BACKGROUND- BLUE REFLECTIVE

NO.	REVISION:	BY:	DATE:
2	CHANGE "DETAILS" TO "STANDARDS" IN TITLE	JDF	07.20.05
1	UPDATE DETAIL SHEET DESIGNATION	JDF	06.20.05

- CITY OF SAN ANTONIO
TRAFFIC ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS

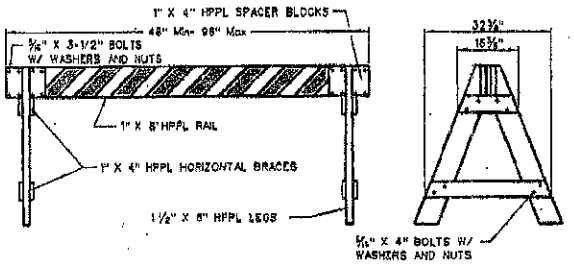
TRAFFIC STANDARDS

BARRICADE AND CONSTRUCTION STANDARDS

TE-BC(2)-05

DESIGNED: EWM	CHECKED: JDF		SHT. NO.
DRAWN: AFG	CHECKED: EWM		2 OF 4
REVISED: AFG	CHECKED: JDF	SCALE: NOT TO SCALE	

Type I BARRICADE



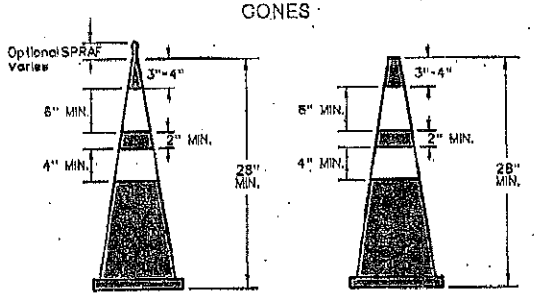
1.) Only the following Type I barricade shall be used in the City of San Antonio Right-Of-Way:
   A. 1" x 8" plastic rail with 2" x 8" wooden legs.
   B. 1" x 8" wooden rail with plastic legs.
   C. 1" x 8" wooden rail with 2" x 6" wood legs.
   D. No screws allowed for assembly of A-legs or rail.
   E. Warning lights will be used as directed by the Traffic Engineer.
   F. All Type I (4') barricades will be a minimum of 36" high and 80" wide. (For Construction Use Only)
   G. All Type I (8') barricades with wooden legs shall be 2" X 6" wood only.
   H. All Type I (4') barricades with wooden legs shall be 1" X 8" wood only.

2.) Type I Barricades shall not be used for partial and total street closures in construction work zones. Only Type III barricades shall be used for this purpose.

3.) Warning lights shall not be mounted on Type I barricades.

(See TxDOT BC-03 Sheets for specific construction information)

CONES

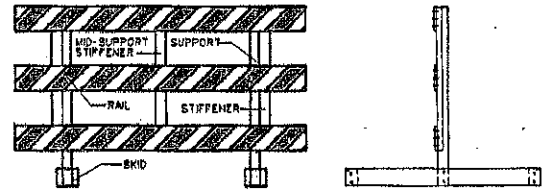


1.) Base for 28" high cones must weigh at least 9.5 lbs.

2.) Night time cones must have reflective collars.

(See TxDOT BC-03 Sheets for specific construction information)

Type III BARRICADE



1.) Only the following Type III barricade shall be used in the City of San Antonio Right-Of-Way.
   A. Hollow polyvinyl or fiberglass tubing post with 1" X 8" wooden rails.
   B. Hollow polyvinyl or fiberglass tubing post with plastic rails.
   C. Skids must be wood or solid plastic only.
   D. Warning lights shall not be mounted on Type III barricades.

(See TxDOT BC-03 Sheets for specific construction information)

TEMPORARY MARKINGS

1.) Solid double yellow painted lines shall be installed for temporary division of traffic or construction duration longer than five (5) days, with repainting to occur once monthly or at the discretion of the Traffic Engineer. (All cost of upkeep will be at the contractor's expense.)

2.) Solid double yellow tabs, or V/P pennels shall be installed for temporary division of traffic for construction duration less than five (5) days, with re-tabbing to occur at the discretion of the Traffic Engineer.
NAILS SHALL NOT BE USED TO FIX TABS TO CEMENT OR BASE
(All cost of upkeep will be at the contractor's expense.)

(See TxDOT BC-03 Sheets for specific construction information.)

TEMPORARY CONCRETE BARRIER

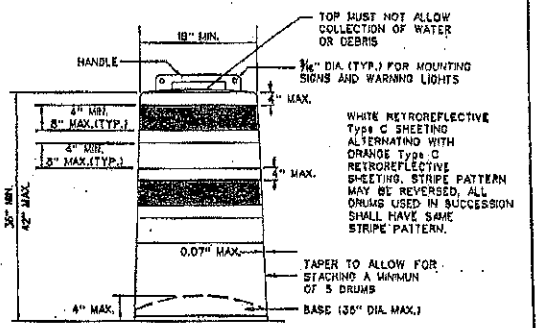
1.) All concrete barriers placed on City R.O.W. shall be low profile.

2.) No high profile barriers will be allowed.

3.) Reflectors will be required on each concrete barrier.

(See TxDOT BC-03 Sheets for specific construction information)

PLASTIC DRUMS



1.) Drums and all related items shall comply with the requirements of the current version of the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD) and the "Compliant Work Zone Traffic Control Devices List" (CWZTCD).

2.) Drums, bases, and related materials shall exhibit good workmanship and shall be free from objectionable marks or defects that would adversely effect their appearance or serviceability.

3.) The Engineer/Inspector shall provide written notice to the Contractor regarding the replacement of drums or other traffic control devices. The Contractor shall have a maximum of 24 hours to replace any plastic drums or other traffic control devices identified for replacement by the Engineer/Inspector. The replacement device must be an approved device.

4.) Each drum must have a 40 lb. rubber or plastic snap on.

5.) No signs larger than 18" X 24" will be allowed to be mounted on plastic drums.

6.) No warning lights will be allowed to be mounted on plastic barrels.

7.) In lieu of a warning light, a yellow reflector will be acceptable.

(See TxDOT BC-03 Sheets for specific construction information)

NO.	REVISION	BY	DATE
2	CHANGE "DETAILS" TO "STANDARDS" IN TITLE	JDF	07.20.05
1	UPDATE DETAIL SHEET DESIGNATION	JDF	06.20.05

CITY OF SAN ANTONIO
TRAFFIC ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS

TRAFFIC STANDARDS

BARRICADE AND CONSTRUCTION STANDARDS

TE-BC(3)-05

DESIGNED: EHK	CHECKED: JDF		SHT. NO.
DRAWN: AFS	CHECKED: EHK		3 OF 4
REVISED: AFS	CHECKED: JDF	SCALE:	NOT TO SCALE

SIGNS

1.) A maximum of two signs can be mounted on any one Long/Intermediate Term Stationary Portable Sign Support.

2.) 48" X 48" signs shall be mounted separately on the Long/Intermediate Term Stationary Portable Sign Support.

3.) For Short Term Stationary Portable Sign Support the distance from the bottom of the vinyl sign to the exiting ground must be one (1) foot.

4.) Long/Intermediate Term Stationary Portable Signs must be made of wood or plastic only.

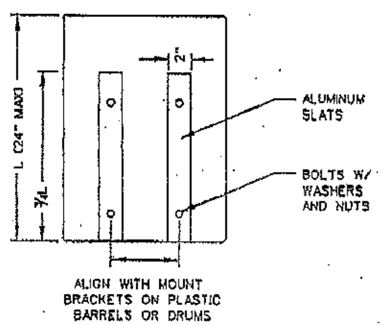
5.) No signs shall be mounted to any Type I, Type III, or folding barricades.

6.) Signs shall be mounted only on TxDOT approved sign supports.

7.) Detour signs will be mounted on single "D" legs w/ 7' clearance from the bottom of the sign.

8.) WORK DURATION TERMINOLOGY
Long Term Stationary = occupies a location 3 or more days;
Intermediate-Term Stationary = occupies a location for overnight to 3 days.
Short Term Stationary = daylight work that occupies a location from **1 to 12 hours.**
Short Duration = occupies a location up to 1 hour.

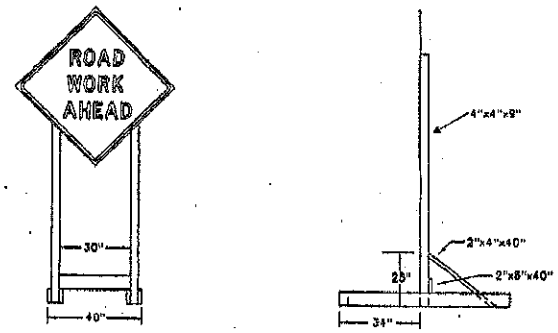
9.) Signs shall adhere to the following requirements:
- Signs placed on plastic barrels or drums shall be made of ABS plastic or plywood.
- Signs placed on skids shall be made of plywood or aluminum.
- Aluminum signs shall have a minimum thickness of 0.08".
- Plywood signs shall have a *minimum* thickness of ½".
- ABS Plastic signs shall have a minimum thickness of 0.13".
  Plastic signs cannot exceed 18" by 24" in size and shall be reinforced with 2" wide, 0.08" thick aluminum slats, as depicted below:



- No other material shall be accepted without the express written approval of the Traffic Egineer.

(See TxDOT BC-03 Sheets for specific construction information.)

LONG TERM / INTERMIDIATE TERM SIGN SUPPORT



1.) 48" X48" signs must be mounted independently.

2.) A maximum of two signs can be mounted on any one long term/intermediate sign support.

3.) Sand bag all sign supports.

4.) Distance from the bottom of the sign to the existing ground shall be 7'.

5.) Distance from the header barricade rail to the face of the sign panel shall be 2' min and 10' max.

6.) Steel tripods shall not be allowed.

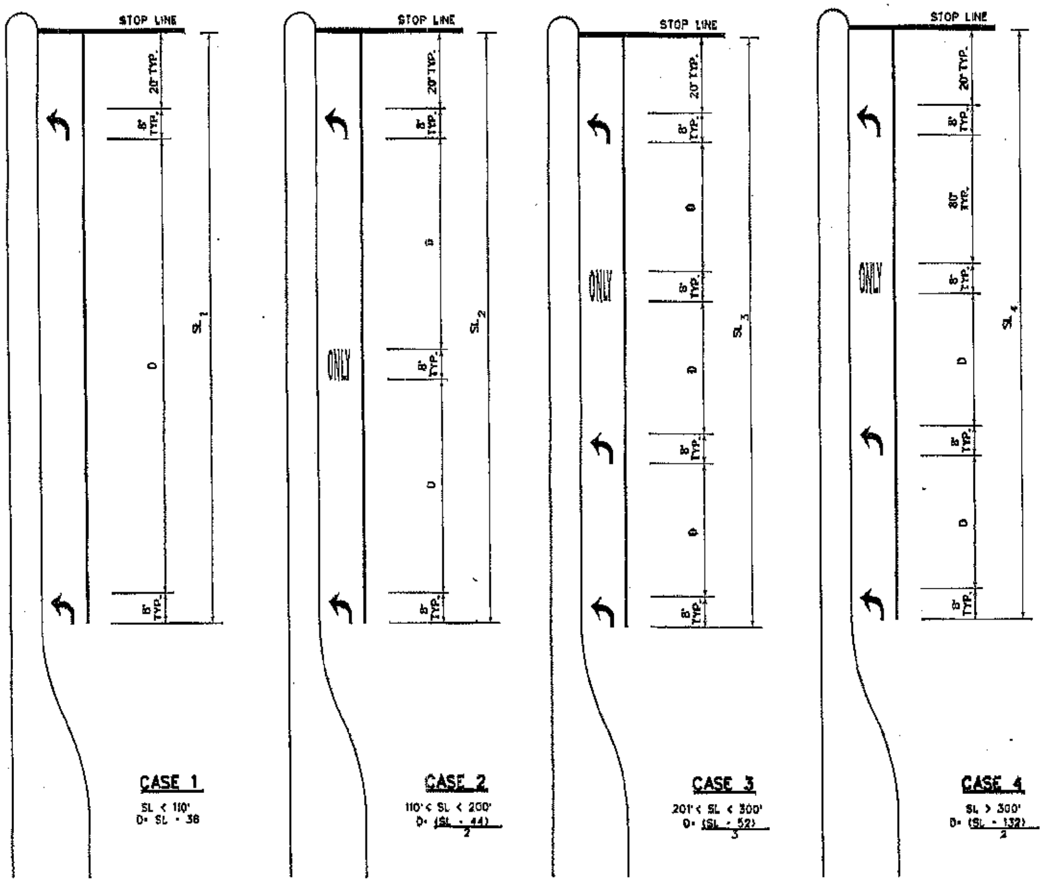
(See TxDOT BC-03 Sheets for specific construction information)

NO.	REVISION	BY:	DATE:
2	CHANGE "DETAILS" TO "STANDARDS" IN TITLE	JDF	07.20.05
1	UPDATE DETAIL SHEET DESIGNATION	JDF	06.20.05

CITY OF SAN ANTONIO
TRAFFIC ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS

TRAFFIC STANDARDS
BARRICADE AND CONSTRUCTION STANDARDS
BC-SA(4)-05

DESIGNED: EMM	CHECKED: JOF		SHT. NO.
DRAWN: AFG	CHECKED: EMM		4 OF 4
REVISED: AFG	CHECKED: JOF	SCALE:	NOT TO SCALE



CASE 1
SL < 110'
D = SL - 36

CASE 2
110' < SL < 200'
$D = \frac{(SL - 44)}{2}$

CASE 3
201' < SL < 300'
$D = \frac{(SL - 52)}{3}$

CASE 4
SL > 300'
$D = \frac{(SL - 132)}{2}$

KEY:

SL - STORAGE LENGTH (FEET)

D - DISTANCE BETWEEN ARROWS AND LEGENDS (FEET)

GENERAL NOTES:

1. THESE DETAILS ALSO APPLY TO RIGHT-TURN LANES.
2. FOR DUAL-TURN LANES, DIMENSIONS SHALL BE THE SAME FOR EACH LANE.
3. SL DIMENSION IS FROM STOP LINE TO END OF TURN LANE, WHICH DOES NOT INCLUDE TAPER LENGTH.
4. PAVEMENT ARROWS AND "ONLY" LEGEND MARKINGS ARE TYPICALLY USED AT SIGNALIZED INTERSECTIONS AND AT UNSIGNALIZED INTERSECTIONS WHERE A DEMONSTRATED NEED EXISTS.
5. MINIMUM SL = 110'. SL MAY BE LESS THAN 110 FEET AS DIRECTED BY THE CITY TRAFFIC ENGINEER.

SEPTEMBER 2009

CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

TRAFFIC ENGINEERING STANDARDS

LEFT-TURN "ONLY" AND ARROW SPACING WORKSHEET

SHEET 1 OF 15

% SUBMITTAL	PROJECT NO.:		DATE:
DRWN. BY: LAV	DSGN. BY: OSV	CHKD. BY: MB	SHEET NO.: OF

SEPTEMBER 2009

CITY OF SAN ANTONIO

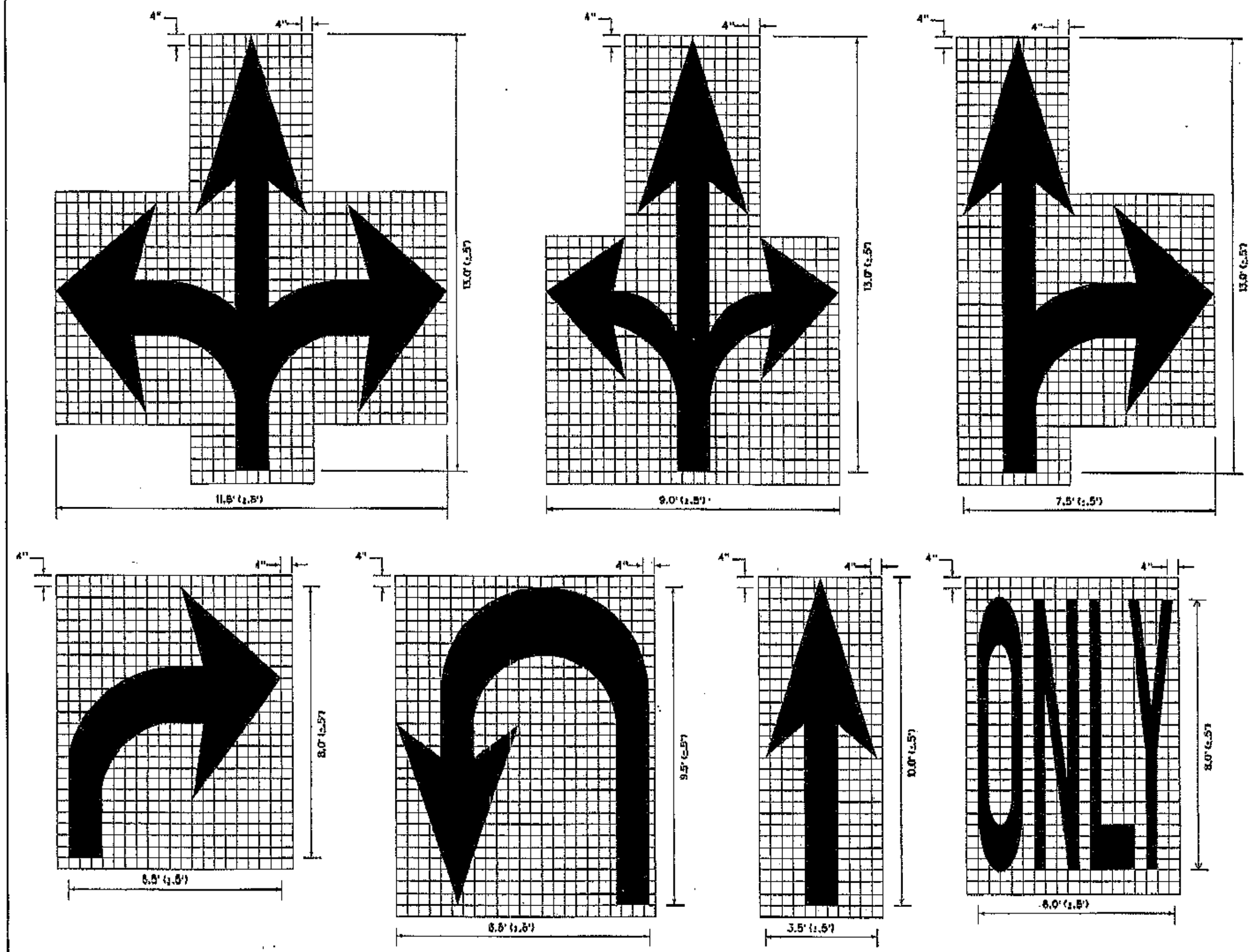
DEPARTMENT OF PUBLIC WORKS

TRAFFIC ENGINEERING STANDARDS

STANDARD PAVEMENT MARKINGS (WORDS)

SHEET 2 OF 16

# SUBMITTAL	PROJECT NO.:	DATE:
DRAWN BY:	DESIGN BY:	SHEET NO.:



NOTES:

1. MINIMUM 8 FOOT WHITE MARKINGS SHALL BE USED, UNLESS OTHERWISE NOTED. IF MESSAGE CONSISTS OF MORE THAN ONE WORD, IT SHOULD BE PLACED WITH FIRST WORD NEAREST THE DRIVER.
2. THESE DETAILS ARE STANDARD SIZE FOR NORMAL INSTALLATION. SIZES MAY BE REDUCED APPROXIMATELY ONE-THIRD DEPENDING ON CONDITIONS.
3. THE LONGITUDINAL SPACE BETWEEN MARKINGS SHOULD BE 30 FEET.
4. MARKINGS CONSIDERED APPROPRIATE FOR USE WHEN WARRANTED INCLUDE THE FOLLOWING:
   A. REGULATORY
      STOP
      RIGHT (LEFT) TURN ONLY
      25 MPH
      SYMBOL ARROWS
   B. WARNING
      STOP AHEAD
      SIGNAL AHEAD
      SCHOOL
      SCHOOL X-ING
      PED X-ING
      R X R (SEE RCPM DETAIL)
      OTHER WORDS OR SYMBOLS MAY BE NECESSARY UNDER CERTAIN CONDITIONS
5. UNCONTROLLED USE OF PAVEMENT MARKINGS CAN RESULT IN DRIVER CONFUSION. WORD AND SYMBOL MARKINGS SHOULD BE NO MORE THAN THREE LINES.
6. THE WORD "STOP" SHALL NOT BE USED ON THE PAVEMENT UNLESS ACCOMPANIED BY A STOP LINE AND STOP SIGN. THE WORD "STOP" SHALL NOT BE PLACED ON THE PAVEMENT IN ADVANCE TO A STOP LINE, UNLESS EVERY VEHICLE IS REQUIRED TO STOP AT ALL TIMES.
7. PAVEMENT MARKINGS SHOULD GENERALLY BE NO MORE THAN ONE LANE IN WIDTH, WITH SCHOOL MESSAGES BEING THE EXCEPTION. FOR DETAILS OF SCHOOL AND SCHOOL CROSSING PAVEMENT MARKINGS, REFER TO PART VII OF THE "TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES".
8. SPACING BETWEEN LETTERS SHOULD BE APPROXIMATELY 4 INCHES. THE WIDTH OF LETTERS MAY VARY DEPENDING ON THE WIDTH OF THE TRAVEL LANES.
9. LANE-USE ARROW MARKINGS MAY BE USED TO CONVEY EITHER GUIDANCE OR MANDATORY MESSAGES. ARROWS USED TO CONVEY A MANDATORY MOVEMENT MUST BE ACCOMPANIED BY STANDARD SIGNS AND THE PAVEMENT MARKING WORD "ONLY".
10. PAVEMENT MARKINGS ARE TO BE LOCATED AS SPECIFIED ELSEWHERE IN THE PLANS.

SEPTEMBER 2009

CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

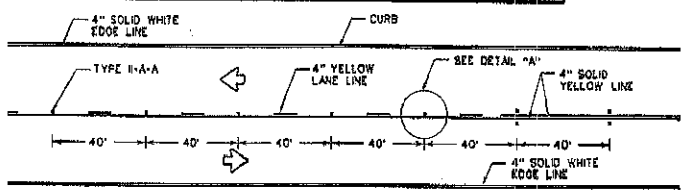
TRAFFIC ENGINEERING STANDARDS

STANDARD PAVEMENT MARKINGS (ARROWS)

SHEET 3 OF 16

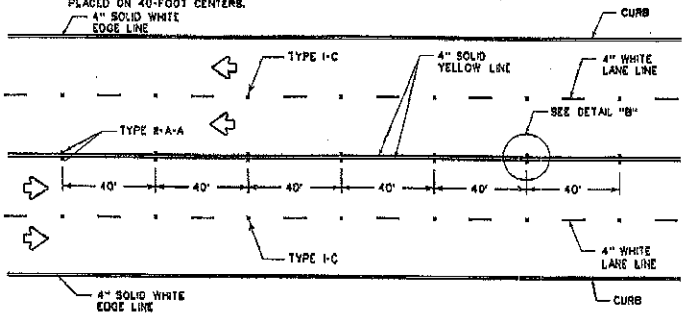
% SUBMITTAL	PROJECT NO.:		DATE:
DRWN. BY: LAM	DSGN. BY: D.E.V.	CHKD. BY: M.K.	SHEET NO.: CP

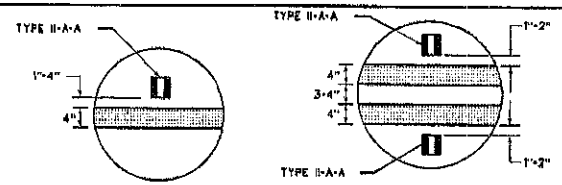
CENTERLINE & EDGE FOR ALL TWO LANE STREETS WITH PASSING ZONE



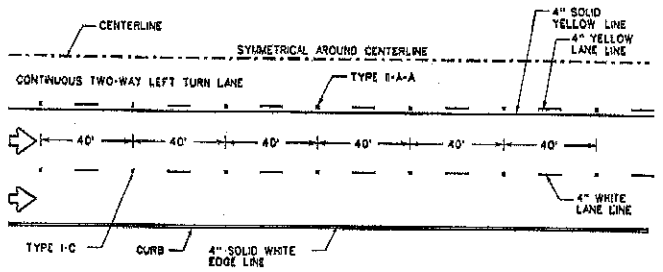
CENTERLINE, LANE LINES & EDGE LINES FOR FOUR LANE TWO-WAY STREETS

RAISED PAVEMENT MARKER TYPE I-C, CLEAR FACE TOWARD NORMAL TRAFFIC, SHALL BE PLACED ON 40-FOOT CENTERS.





CENTERLINE, LANE LINES, & EDGE LINES FOR TWO-WAY LEFT TURN LANE



LANE LINES & EDGE LINES FOR ONE-WAY MULTILANE STREET

RAISED PAVEMENT MARKERS TYPE II-C-R SHALL HAVE CLEAR FACE TOWARD NORMAL TRAFFIC AND RED FACE TOWARD WRONG-WAY TRAFFIC.

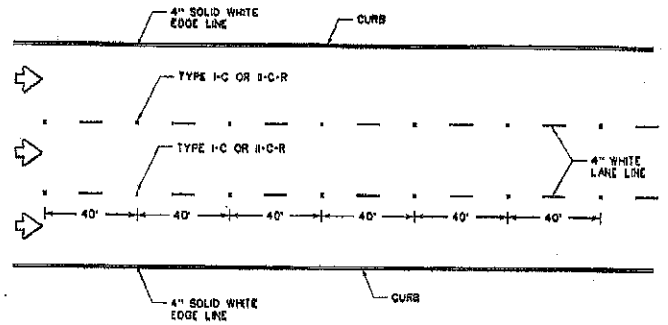


TABLE 1 - TYPICAL LENGTH (L)

* POSTED SPEED	FORMULA
45>	$L = \frac{WS^2}{60}$
≥45	L = WS

* 85TH PERCENTILE SPEED MAY BE USED ON ROADS WHERE TRAFFIC SPEEDS NORMALLY EXCEED THE POSTED SPEED LIMIT. CROSSHATCHING LENGTH SHOULD BE ROUNDED UP TO NEAREST 5 FOOT INCREMENT.

L = LENGTH OF CROSSHATCHING (FT)
W = WIDTH OF OFFSET (FT)
S = POSTED SPEED (MPH)

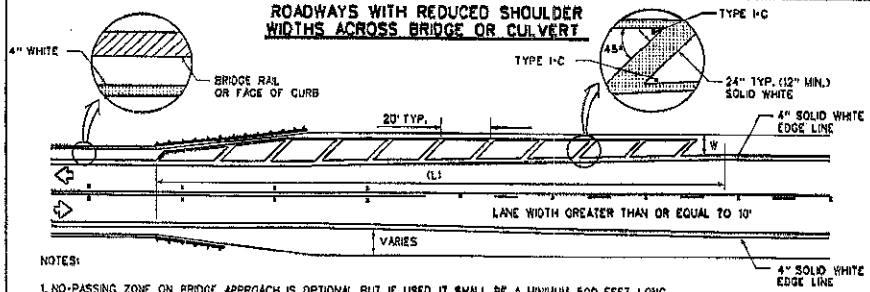
EXAMPLES:
AN 8 FOOT SHOULDER IN ADVANCE OF A BRIDGE REDUCES TO 4 FEET ON A 70 MPH ROADWAY. THE LENGTH OF THE CROSS-HATCHING SHOULD BE:
L=8X70=560 FT
A 4 FOOT SHOULDER IN ADVANCE OF A BRIDGE REDUCES TO 2 FEET ON A 40 MPH ROADWAY. THE LENGTH OF THE CROSS-HATCHING SHOULD BE:
L= 4(40)² / 60= 106.67 FT ROUNDED TO 110 FT

YIELD LINES

GENERAL NOTES:

1. EDGELINE ADJACENT TO CURB AND GUTTER IS NOT REQUIRED IN ALL CASES, HOWEVER SHALL BE PLACED AS DIRECTED BY CITY TRAFFIC ENGINEER.
2. THE TRAVELED WAY INCLUDES ONLY THAT PORTION OF THE ROADWAY USED FOR VEHICULAR TRAVEL AND NOT THE PARKING LANES, SIDEWALKS, BERMS AND SHOULDERS. THE TRAVELED WAYS SHALL BE MEASURED FROM THE INSIDE OF EDGELINE TO INSIDE OF EDGELINE OF A TWO LANE ROADWAY.
3. ALL RAISED PAVEMENT MARKERS PLACED IN BROKEN LINES SHALL BE PLACED IN LINE WITH AND MIDWAY BETWEEN THE STRIPES.
4. ON CONCRETE PAVEMENTS THE RAISED PAVEMENT MARKERS SHOULD BE PLACED TO ONE SIDE OF THE LONGITUDINAL JOINTS.
5. ALL PAVEMENT MARKING MATERIAL SHALL MEET THE REQUIRED MATERIAL SPECIFICATIONS AS SPECIFIED BY CITY OF SAN ANTONIO STANDARD SPECIFICATIONS.
6. 4" SOLID WHITE EDGE LINES ARE OPTIONAL AS DIRECTED BY THE CITY TRAFFIC ENGINEER.

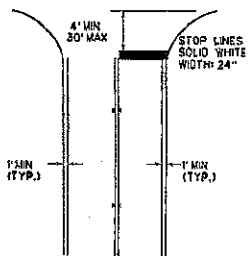
ROADWAYS WITH REDUCED SHOULDER WIDTHS ACROSS BRIDGE OR CULVERT



NOTES:

1. NO-PASSING ZONE ON BRIDGE APPROACH IS OPTIONAL BUT IF USED, IT SHALL BE A MINIMUM 500 FEET LONG.
2. FOR CROSSHATCHING LENGTH (L) SEE TABLE 1.
3. THE WIDTH OF THE OFFSET (W) AND THE REQUIRED CROSSHATCHING WIDTH IS THE FULL SHOULDER WIDTH IN ADVANCE OF THE BRIDGE.
4. THE CROSSHATCHING SHOULD BE REQUIRED IF THE SHOULDER WIDTH IN ADVANCE OF THE BRIDGE IS 4 FOOT OR WIDER AND ANY REDUCTION IN SHOULDER WIDTH ACROSS THE BRIDGE OCCURS.

GUIDE FOR PLACEMENT OF STOP LINES, EDGE LINE & CENTERLINE



SEPTEMBER 2009

CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

TRAFFIC ENGINEERING STANDARDS

STANDARD PAVEMENT MARKINGS WITH REFLECTIVE RAISED PAVEMENT MARKERS FOR POSITION GUIDANCE 1

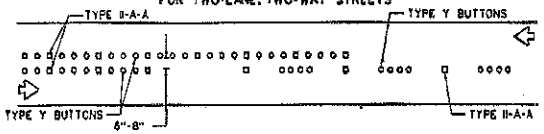
SHEET 4 OF 18

___ SUBMITTAL	PROJECT NO.:		DATE:
DRAWN BY:	DESIGNED BY:	CHKD. BY:	SHEET NO.:

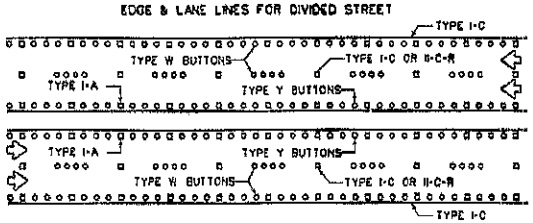
RAISED PAVEMENT MARKING PLACEMENT PATTERNS

PLACED W/ REFLECTION PAVEMENT MARKERS (OPTIONAL)

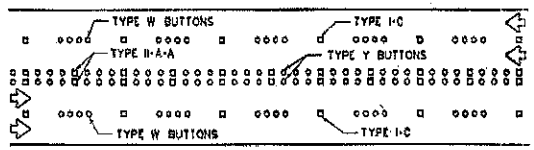
CENTER LINE & NO-PASSING ZONE BARRIER LINES FOR TWO-LANE, TWO-WAY STREETS



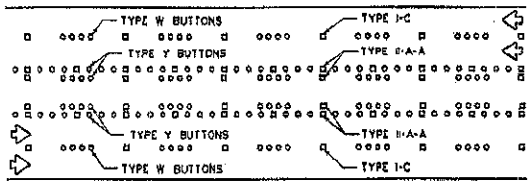
EDGE & LANE LINES FOR DIVIDED STREET



LANE & CENTER LINES FOR MULTILANE UNDIVIDED STREETS



TWO-WAY LEFT TURN LANE

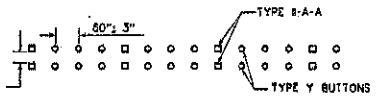


RAISED PAVEMENT MARKINGS PLACEMENT DETAILS

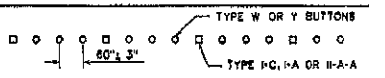
PLACED W/ REFLECTION PAVEMENT MARKERS (OPTIONAL)

SOLID LINES

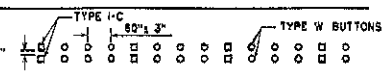
DOUBLE NO-PASSING LINE — RAISED PAVEMENT MARKERS



EDGE LINE OR SINGLE NO-PASSING LINE — RAISED PAVEMENT MARKERS

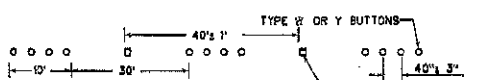


WIDE LINE — RAISED PAVEMENT MARKERS



(FOR LEFT TURN CHANNELIZING LINE OR CHANNELIZING LINE USED TO DISCOURAGE LANE CHANGING.)

BROKEN LINE — RAISED PAVEMENT MARKERS

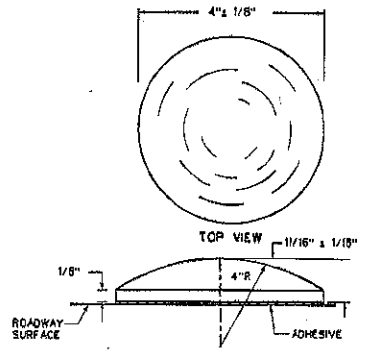


(FOR CENTER LINE OR LANE LINE.)

TRAFFIC BUTTONS

(NON-REFLECTORIZED)

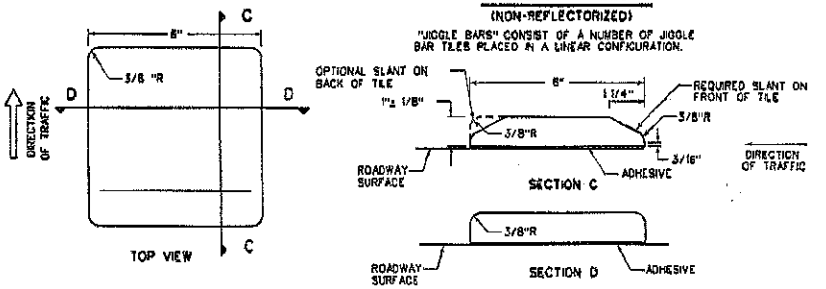
NOTE: MINIMUM AREA OF MARKERS SHALL BE NOT LESS THAN 12.5 SQUARE INCHES.



JIGGLE BAR TILES

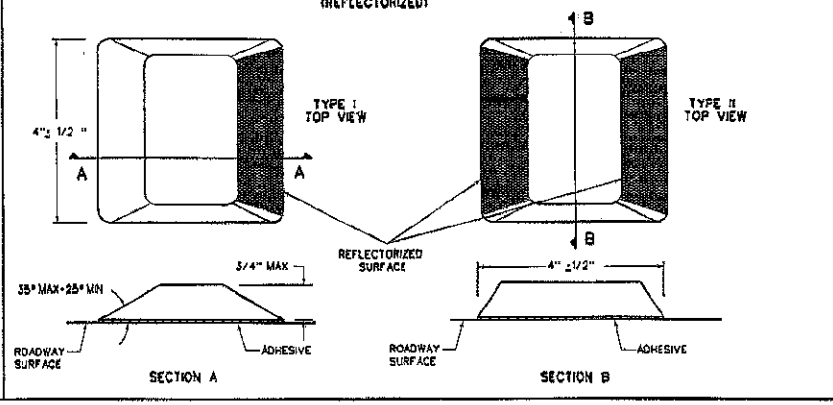
(NON-REFLECTORIZED)

"JIGGLE BARS" CONSIST OF A NUMBER OF JIGGLE BAR TILES PLACED IN A LINEAR CONFIGURATION.



RAISED PAVEMENT MARKERS

(REFLECTORIZED)



NOTES:

1. RAISED PAVEMENT MARKERS (RPMs) MAY CONSIST OF TRAFFIC BUTTONS, PAVEMENT MARKERS AND/OR JIGGLE BAR TILES. PAVEMENT SURFACE SHALL BE PREPARED AND CLEANED SUBJECT TO APPROVAL OF THE CITY TRAFFIC ENGINEER BEFORE ADHESIVE AND RPMs ARE PLACED.
2. JIGGLE BARS SHALL BE ORIENTED PERPENDICULAR TO ROADWAY. JIGGLE BARS SHALL ALSO BE PLACED AT SUCH OTHER LOCATIONS AS SHOWN IN PLANS OR AS DIRECTED BY THE CITY TRAFFIC ENGINEER.
3. MARKERS, BUTTONS AND JIGGLE BAR TILES SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY AND NOT INTENDED TO SPECIFY ANY PARTICULAR PRODUCT. ALL PAVEMENT MARKERS PROVIDED SHALL BE OF THE SAME MANUFACTURER.
4. ALL DIMENSIONS ARE +/- 1/8" UNLESS OTHERWISE NOTED.
5. ALL PAVEMENT MARKING MATERIALS SHALL MEET MATERIAL SPECIFICATIONS AS SPECIFIED BY CITY OF SAN ANTONIO STANDARD SPECIFICATIONS.
6. TRAFFIC BUTTONS AND JIGGLE BAR TILES ARE TO BE USED ONLY FOR TEMPORARY TRAFFIC CONTROL OR AS DIRECTED BY THE CITY TRAFFIC ENGINEER.

SEPTEMBER 2009

CITY OF SAN ANTONIO

DEPARTMENT OF PUBLIC WORKS

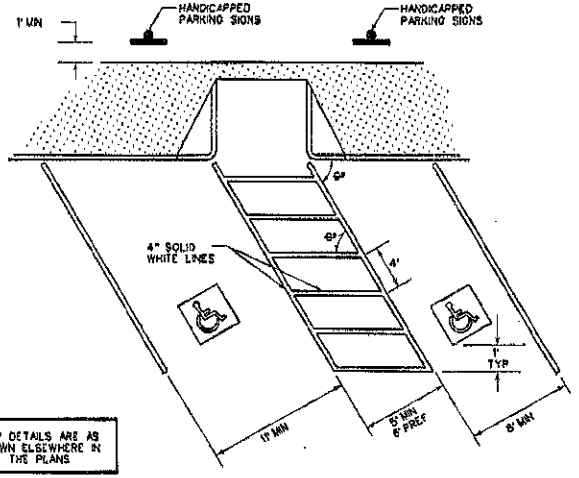
TRAFFIC ENGINEERING STANDARDS

RAISED PAVEMENT MARKERS, REFLECTIVE PAVEMENT MARKERS, TRAFFIC BUTTONS & JIGGLE BAR TILES 2

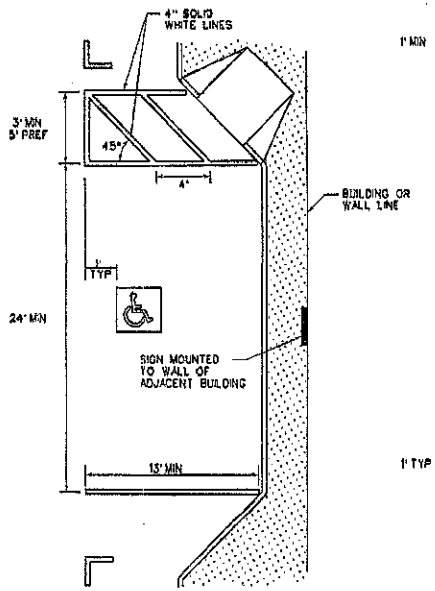
SHEET 3 OF 18

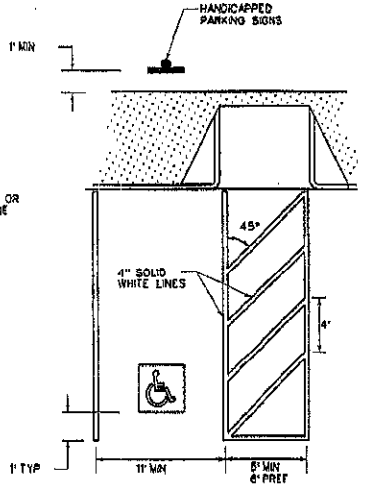
# SUBMITTAL	PROJECT NO.:		DATE:
DRWN BY: JAV	DSGN BY: CRV	CKD. BY: ALE	SHEET NO. OF

TYPICAL ACCESSIBLE PARKING SPACE DIMENSIONS

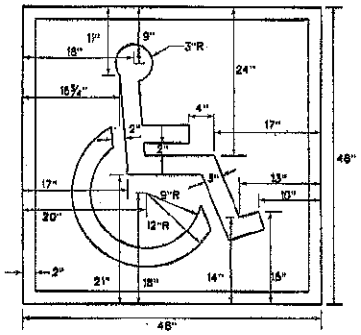


RAMP DETAILS ARE AS SHOWN ELSEWHERE IN THE PLANS

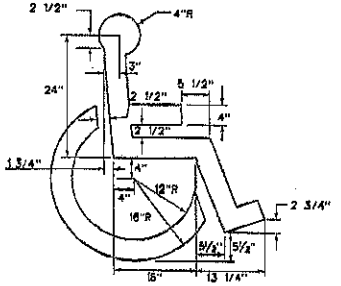




PAVEMENT MARKINGS



WITH BACKGROUND
SYMBOL & BORDER: WHITE
BACKGROUND: BLUE



SYMBOL ONLY
SYMBOL: BLUE OR WHITE

NOTES:

1. ALL PARKING SPACE LIMIT LINES SHALL BE 4" SOLID WHITE LINES.
2. AISLE MARKINGS SHOWN ARE EXAMPLES ONLY. OTHER METHODS TO INDICATE A NO PARKING AREA ARE ACCEPTABLE. AISLE MARKINGS SHALL BE WHITE.
3. DIMENSIONS OF LIMIT LINES, AISLE MARKINGS, AND SYMBOL (WITH OR WITHOUT BACKGROUND) MAY VARY ± 10%.
4. PAVEMENT MARKING SYMBOLS (WITH BACKGROUND):
   A) ARE REQUIRED UNLESS STATED ELSEWHERE IN THE PLANS.
   B) SHOULD BE PLACED TOWARD THE FAR END OF THE PARKING SPACES SO AS TO BE VISIBLE TO MOTORISTS IN THE TRAVEL LANE.
   C) MAY BE PAINTED OR PREFABRICATED MATERIAL, AND
   D) SHALL BE 30"×30" MINIMUM.
5. WITH APPROVAL OF THE CITY TRAFFIC ENGINEER, PREFABRICATED PAVEMENT MARKING SYMBOLS WITH BACKGROUND OF OTHER DIMENSIONS EXCEEDING THE 30"×30" MINIMUM MAY BE USED. ALTERNATIVE DESIGNS SHALL INCLUDE A PROPORTION SIZED SYMBOL OF ACCESSIBILITY, AND SHALL CONFORM TO THE ILLUSTRATED COLORS FOR BACKGROUND, SYMBOL AND BORDER.
6. ALL SLOPE IN AND AROUND EXPECTED WHEEL CHAIR PATH SHALL NOT EXCEED 2% X-SLOPES.

SEPTEMBER 2009

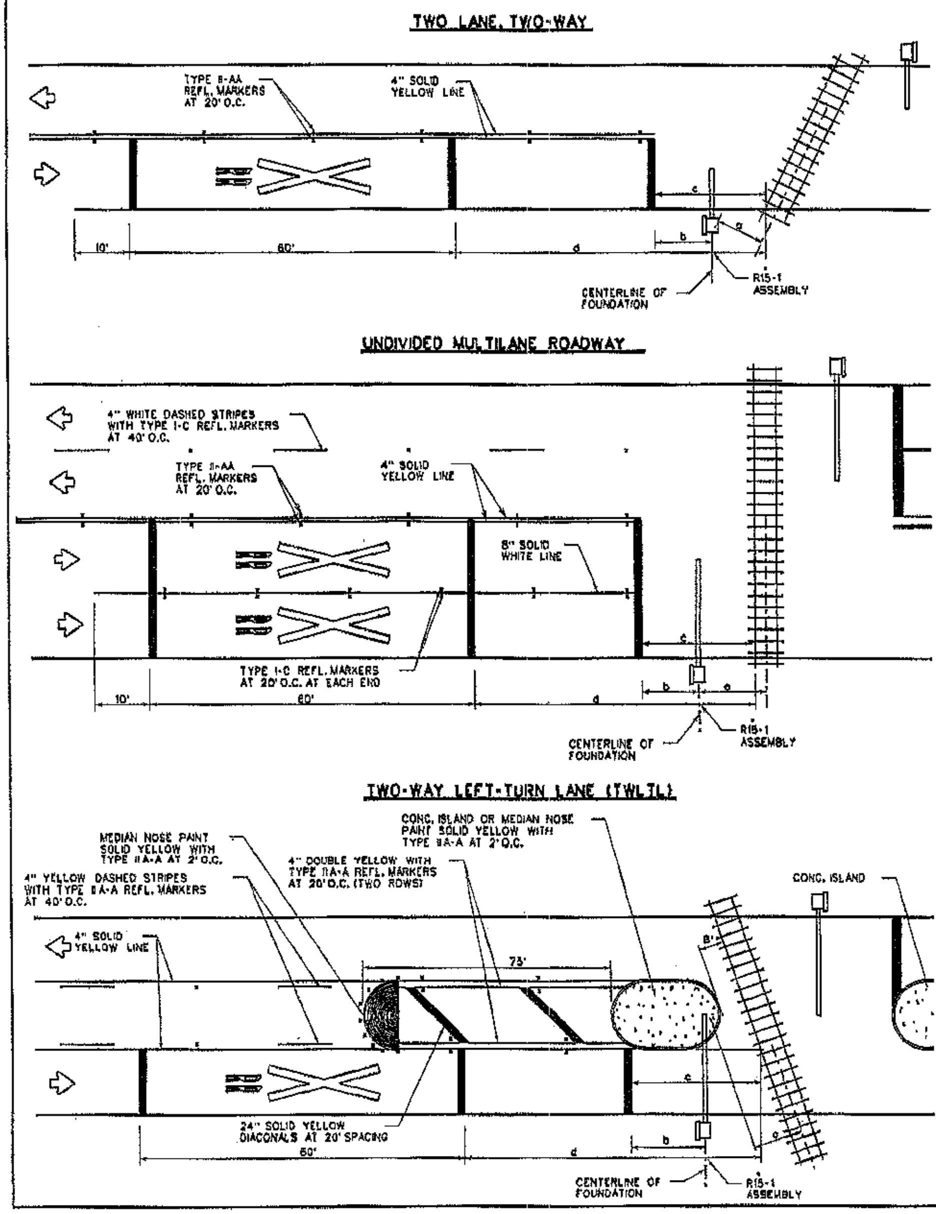
CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

TRAFFIC ENGINEERING STANDARDS

PAVEMENT MARKINGS FOR ACCESSIBLE PARKING

SHEET 6 OF 16

E SUBMITTAL	PROJECT NO.:			DATE:
DRAWN BY: LAV	DESIGN BY: CLV	CHKD. BY: [illegible]		SHEET NO.: OF



a : 12 FEET MINIMUM, 15 FEET USUAL, IF ACTIVE WARNING DEVICES ARE PRESENT. DISTANCE "a" SHOULD BE MEASURED FROM THE CENTERLINE OF R15-1 ASSEMBLY TO THE CENTERLINE OF NEAREST TRACK.

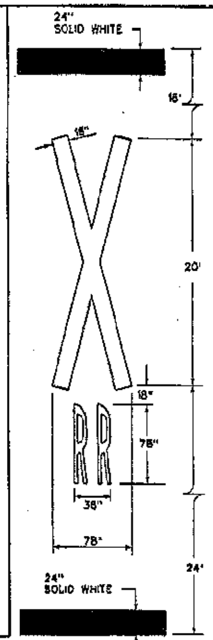
b: STOP LINES SHOULD BE APPROXIMATELY 8 FEET IN ADVANCE OF ACTIVE WARNING DEVICES (TYPE A, E OR F). STOP LINE SHOULD BE APPROXIMATELY 15 FEET FROM NEAR RAIL IF ONLY PASSIVE DEVICES (R15-1, PLUS R15-2 WHEN APPLICABLE) ARE PRESENT.

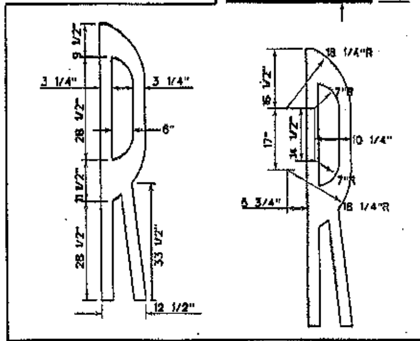
c: 15 FEET DESIRABLE MINIMUM IF NO GATE OR SIGNAL IS PRESENT. R15-1 SHOULD BE PLACED BETWEEN STOP LINE AND RAILS WITH ADEQUATE DISTANCE PROVIDED FOR "a".

d*:

APPROACH SPEED (MPH)	DESIRABLE PLACEMENT (FEET)
20	145
25	220
30	295
35	370
40	445
45	520
50	595
55	670
60	745
65	820
70	900

* LOCAL CONDITIONS MAY REQUIRE ALTERNATE PLACEMENT LOCATIONS.





R15-1 ASSEMBLY

MAY CONSIST OF ONE OR MORE OF THE FOLLOWING:

R15-1	CROSSBUCK SIGN
R15-2	MULTIPLE TRACK SIGN
TYPE A	MAST FLASHERS
TYPE E	CANTILEVERS
TYPE F	GATES

NOTES:

1. THE PAVEMENT MARKINGS ON AN APPROACH TO A RAILROAD GRADE CROSSING SHALL CONSISTS OF:
   A) THE RR X-ING SYMBOL,
   B) THREE TRANSVERSE 24" LINES, AND
   C) LANE LINES: A SOLID NO PASSING LINE FOR TWO-WAY TRAFFIC APPROACHES, OR SOLID LAND LINES FOR MULTILANE APPROACHES.
2. FOR BIDDING PURPOSES, THE RR X-ING SYMBOL WILL BE MEASURED AND PAID FOR AS FOR EACH LANE IN PLACE. THE TRANSVERSE MARKINGS AND LANE LINES WILL BE MEASURED AND PAID FOR BY THE LINEAL FOOT.
3. CENTERLINES SHALL BE YELLOW, OTHER MARKINGS SHALL BE WHITE.
4. APPROACH LANES LESS THAN 8 FOOT WIDTH SHALL NOT HAVE MARKINGS.
5. MARKINGS SHOULD NOT BE PLACED WHERE LESS THAN 110 FEET OF APPROACH ROADWAY IS AVAILABLE FOR PLACEMENT UNLESS DIRECTED BY CITY TRAFFIC ENGINEER.
6. RR X-ING SYMBOLS SHOULD BE PLACED APPROXIMATELY IN THE CENTER OF THE APPROACH LANE.
7. ALL TRANSVERSE MARKINGS, INCLUDING STOP LINES, SHALL BE PLACED AT RIGHT ANGLES TO THE CENTERLINE AND ACROSS ALL APPROACH LANES.
8. EXISTING NON-STANDARD MARKINGS SHALL BE REMOVED TO THE FULLEST EXTENT POSSIBLE SO AS NOT TO LEAVE A DISCERNABLE MARKING, BY ANY METHOD APPROVED BY THE CITY TRAFFIC ENGINEER. OVERPAINTING WILL NOT BE ALLOWED.
9. ADDITIONAL MARKINGS AND PLACEMENT DETAILS MAY BE FOUND IN THE TMUTCD, APPENDIX H.
10. THE CITY TRAFFIC ENGINEER MAY REQUIRE ADDITIONAL LONGITUDINAL MARKINGS IF THE DISTANCE BETWEEN THE STOP LINES IS GREATER THAN 80 FEET. MARKINGS ARE NOT REQUIRED ACROSS OR BETWEEN THE RAILS UNLESS SPECIFIED ELSEWHERE IN THE PLANS.

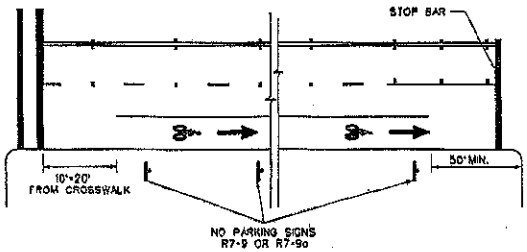
SEPTEMBER 2009

CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

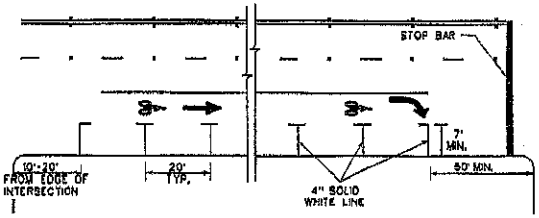
TRAFFIC ENGINEERING STANDARDS
RAILROAD CROSSING PAVEMENT MARKING (RCPM) DETAILS
SHEET 7 OF 16

% SUBMITTAL	PROJECT NO.:		DATE:
DRWN. BY: LAH	DSGN. BY: O.B.V.	CHKD. BY: M.B.	SHEET NO.: OF

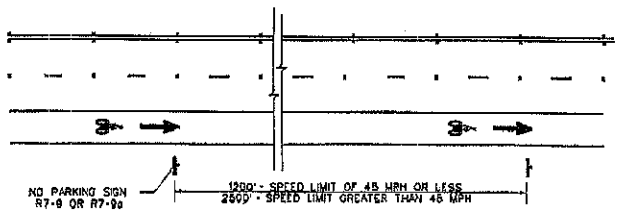
NO PARKING ALONG BICYCLE LANE

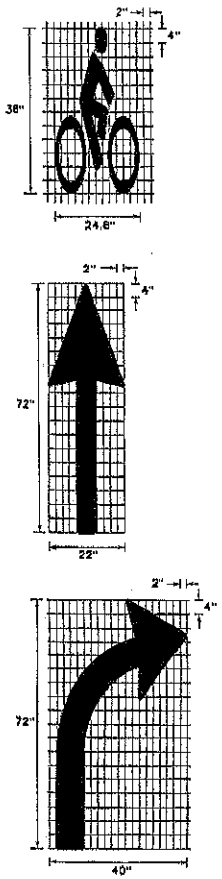


PARKING ALONG BICYCLE LANE

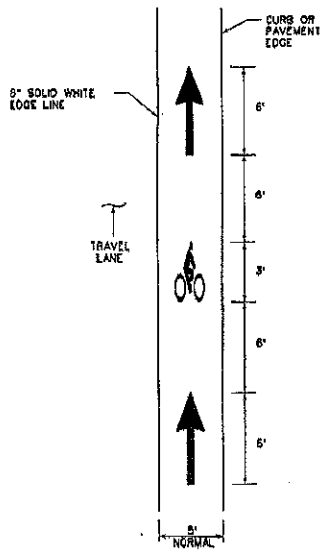


ROADWAYS WITH FEW INTERSECTIONS



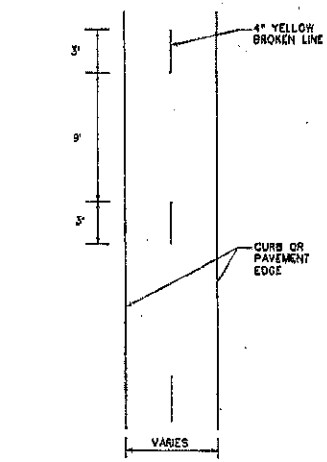


ADJACENT TO TRAVEL LANE

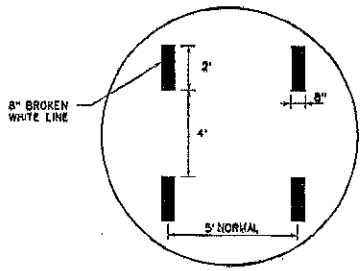


SHARED USE PATH

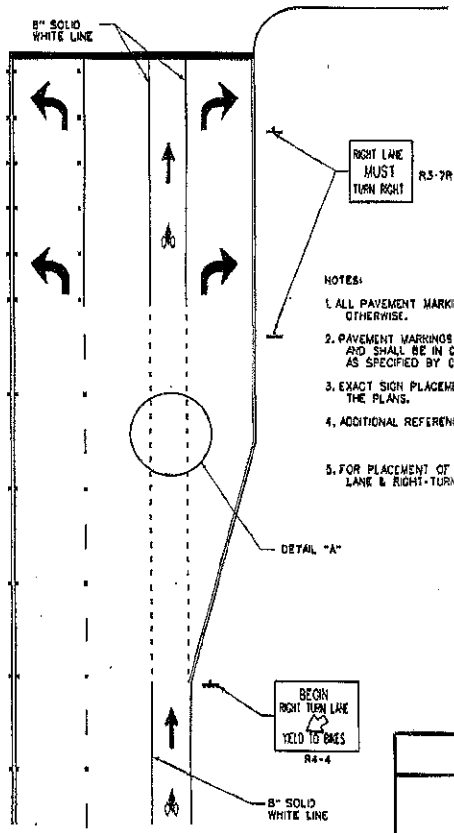
(SEPERATE FROM ROADWAY WITH NO MOTORIZED TRAFFIC)



DETAIL "A"



RIGHT-TURN LANE AT INTERSECTION



NOTES:

1. ALL PAVEMENT MARKINGS SHALL BE WHITE EXCEPT WHEN NOTED OTHERWISE.
2. PAVEMENT MARKINGS SHALL BE OF THE MATERIALS SPECIFIED AND SHALL BE IN CONFORMANCE WITH MATERIAL SPECIFICATIONS AS SPECIFIED BY CITY OF SAN ANTONIO STANDARD SPECIFICATIONS.
3. EXACT SIGN PLACEMENT AND DETAILS ARE SHOWN ELSEWHERE IN THE PLANS.
4. ADDITIONAL REFERENCES: TMUTCD
   GUIDE FOR THE DEVELOPMENT OF BICYCLES FACILITIES, AASHTO, 1991.
5. FOR PLACEMENT OF PAVEMENT ARROWS AND WORDS SEE LEFT-TURN LANE & RIGHT-TURN LANE DESIGN WORKSHEET.

SEPTEMBER 2009

CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

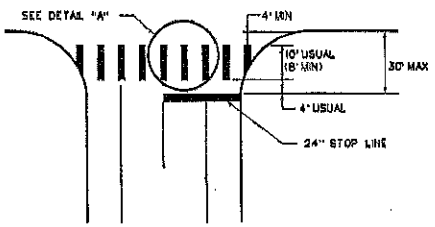
TRAFFIC ENGINEERING STANDARDS

BICYCLE LANE PAVEMENT MARKINGS

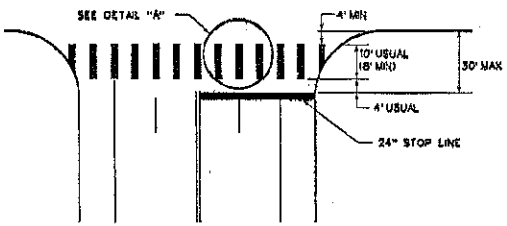
SHEET 8 OF 16

M. SUBMITTAL	PROJECT NO.:		DATE:
DRAWN BY: LAN	DSGN. BY: CBV	CHKD. BY: MF	SHEET NO.: DP

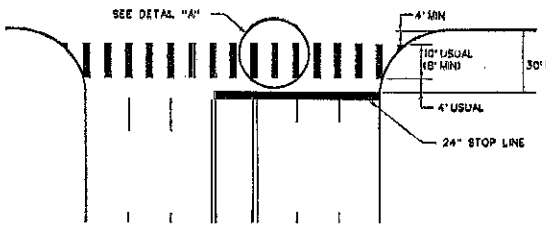
TWO LANES WITH SHOULDERS



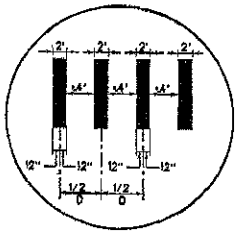
FOUR LANES WITH SHOULDERS



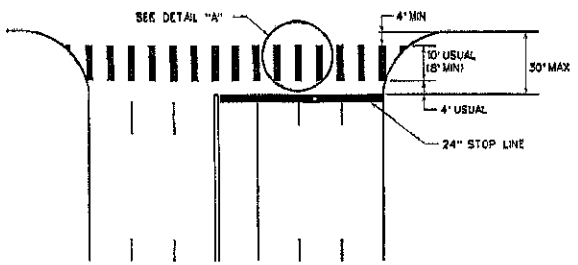
MULTI - LANES



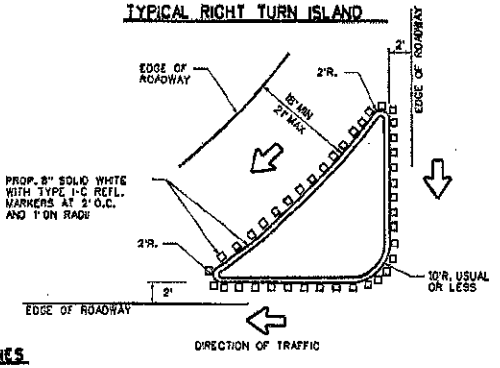
DETAIL "A"



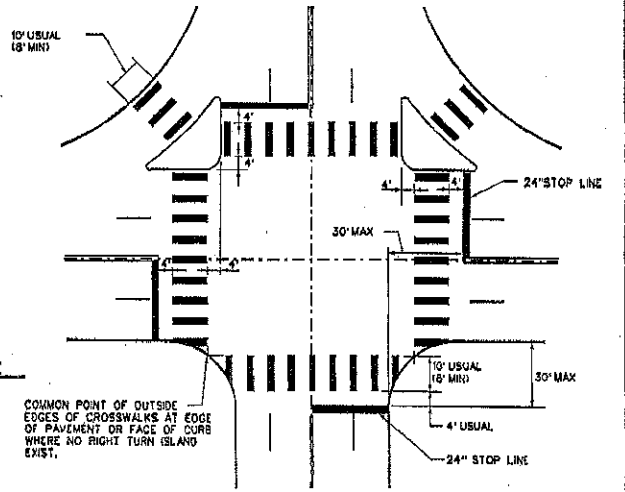
MULTI - LANE WITH MEDIAN



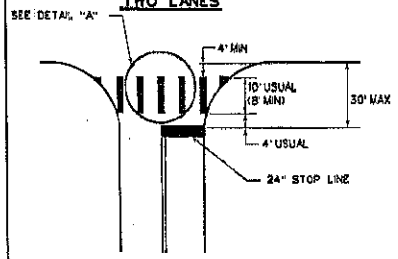
TYPICAL RIGHT TURN ISLAND



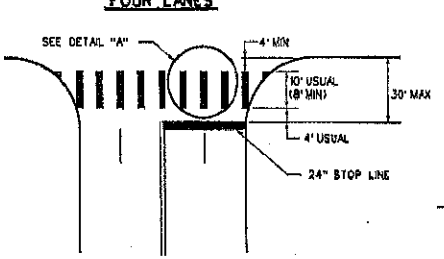
INTERSECTION WITH RIGHT - TURN ISLANDS



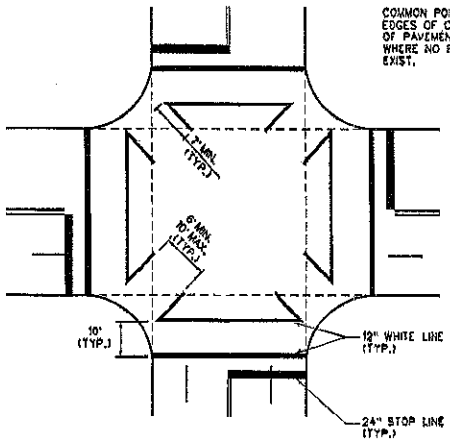
TWO LANES



FOUR LANES



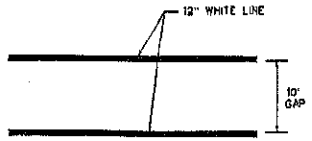
EXCLUSIVE PEDESTRIAN PHASE



NOTES:

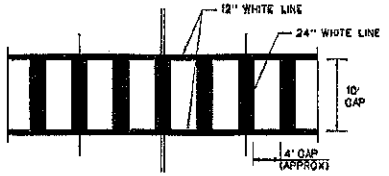
1. CROSSWALKS AND STOP LINES SHALL BE WHITE.
2. "D" IS EQUAL TO ONE HALF THE WIDTH OF TRAVEL LANE.

CENTRAL BUSINESS DISTRICT CROSSWALK DETAIL



HIGH VISIBILITY CROSSWALK DETAIL

TYPICALLY USED AT SIGNALIZED AND NON-SIGNALIZED MID-BLOCK CROSSINGS FOR COLLECTOR AND ARTERIAL ROADWAYS AND AT LOCATIONS REQUIRING EXTRA EMPHASIS.



SEPTEMBER 2009

CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

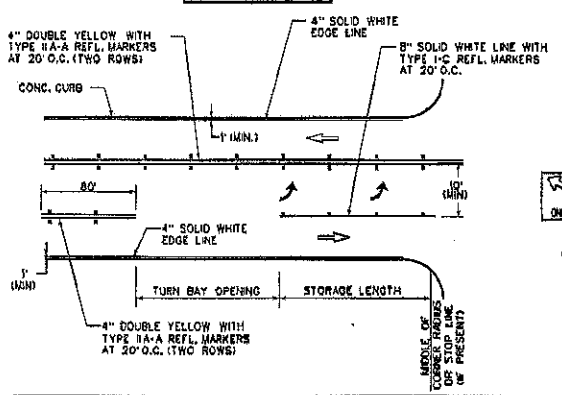
TRAFFIC ENGINEERING STANDARDS

TYPICAL CROSSWALK DETAILS

SHEET 9 OF 16

SUBMITTAL	PROJECT NO.:			DATE:	
DRAWN BY: LAH	DESIGN BY: RSL	CHKD BY: MF		SHEET NO.:	OF

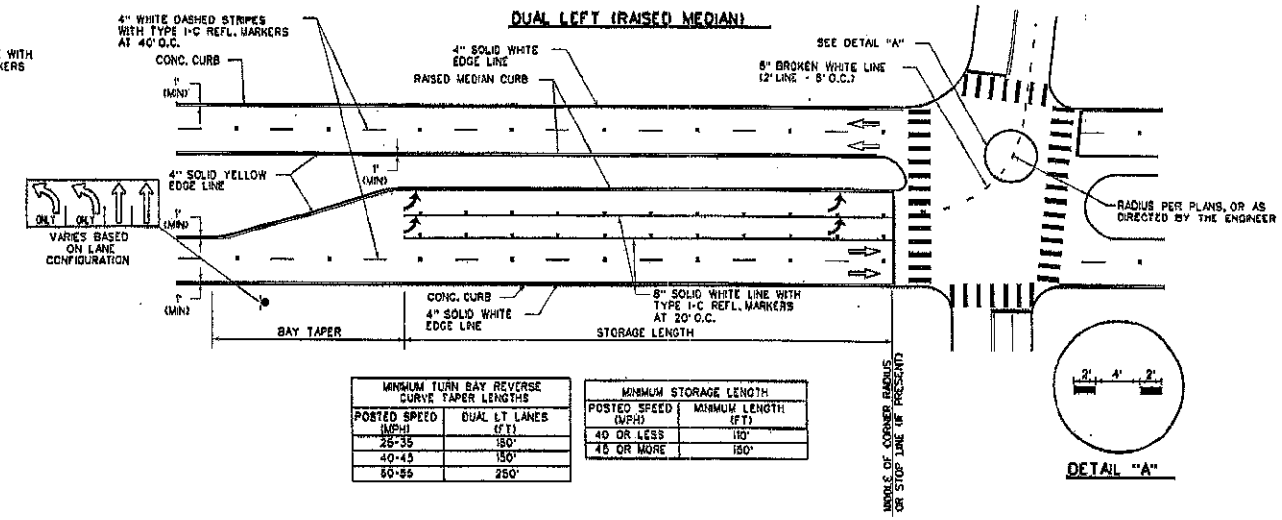
LEFT-TURN LANE



MINIMUM TURN BAY OPENINGS	
POSTED SPEED (MPH)	MINIMUM OPENING (FT)
25-35	80'
≥ 40	100'

MINIMUM STORAGE LENGTH	
POSTED SPEED (MPH)	MINIMUM OPENING (FT)
40 OR LESS	110'
45 OR MORE	150'

DUAL LEFT (RAISED MEDIAN)

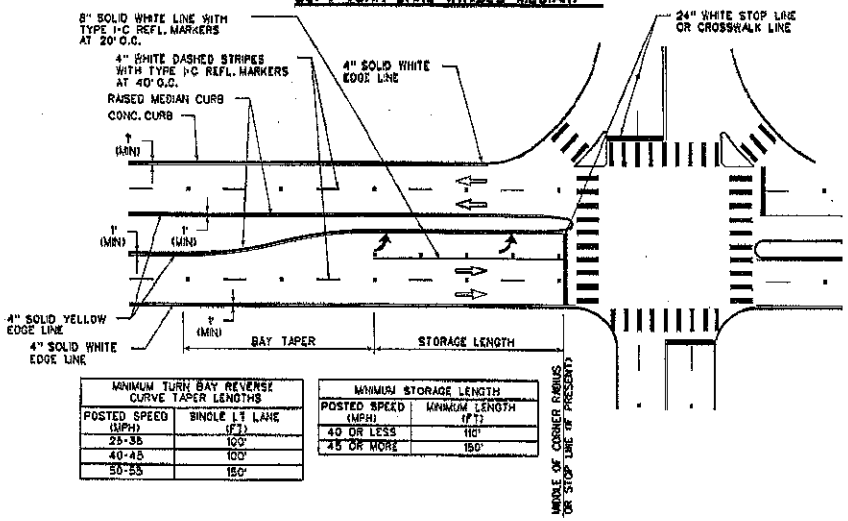


DETAIL "A"

MINIMUM TURN BAY REVERSE CURVE TAPER LENGTHS	
POSTED SPEED (MPH)	DUAL LT LANES (FT)
25-35	150'
40-45	150'
50-55	250'

MINIMUM STORAGE LENGTH	
POSTED SPEED (MPH)	MINIMUM LENGTH (FT)
40 OR LESS	110'
45 OR MORE	150'

LEFT-TURN LANE (RAISED MEDIAN)



MINIMUM TURN BAY REVERSE CURVE TAPER LENGTHS	
POSTED SPEED (MPH)	SINGLE LT LANE (FT)
25-35	100'
40-45	100'
50-55	150'

MINIMUM STORAGE LENGTH	
POSTED SPEED (MPH)	MINIMUM LENGTH (FT)
40 OR LESS	110'
45 OR MORE	150'

NOTES:

1. THE POSTED SPEED LIMIT IS TYPICALLY EQUAL TO THE DESIGN SPEED MINUS 5 MPH.
2. THE DIMENSIONS GIVEN FOR DUAL LEFT (RAISED MEDIAN) IN THE MINIMUM LENGTH TABLES ON THIS SHEET ARE ALSO APPLICABLE FOR DUAL RIGHT-TURN LANES.
3. STORAGE LENGTHS LONGER THAN THE MINIMUMS LISTED ON THIS DRAWING MAY BE DETERMINED USING TRAFFIC ENGINEERING ANALYSIS OR APPROXIMATE CALCULATIONS.
4. FOR THE PLACEMENT OF PAVEMENT ARROWS AND WORDS SEE LEFT-TURN "ONLY" AND ARROW SPACING WORKSHEET.
5. REFER TO APPLICABLE STANDARD PAVEMENT MARKINGS WITH REFLECTIVE RAISED PAVEMENT MARKERS FOR POSITION GUIDANCE AND LEFT-TURN & RIGHT-TURN LANE STANDARD PAVEMENT MARKINGS WITH REFLECTIVE RAISED PAVEMENT MARKINGS.
6. REFER TO BICYCLE LANE PAVEMENT MARKINGS STANDARD FOR TYPE AND PLACEMENT.
7. 4" SOLID WHITE AND YELLOW EDGE LINES ARE OPTIONAL AS DIRECTED BY THE CITY TRAFFIC ENGINEER.

SEPTEMBER 2009

CITY OF SAN ANTONIO

DEPARTMENT OF PUBLIC WORKS

TRAFFIC ENGINEERING STANDARDS

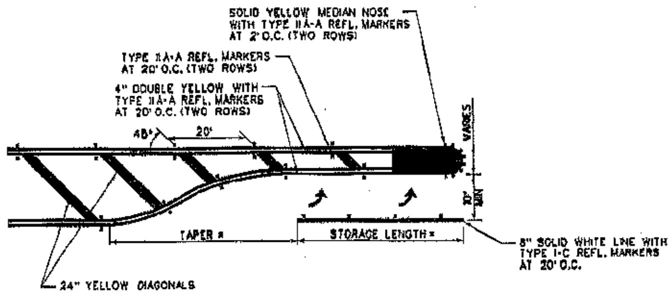
LEFT-TURN LANE & RIGHT-TURN LANE DESIGN WORKSHEET 1

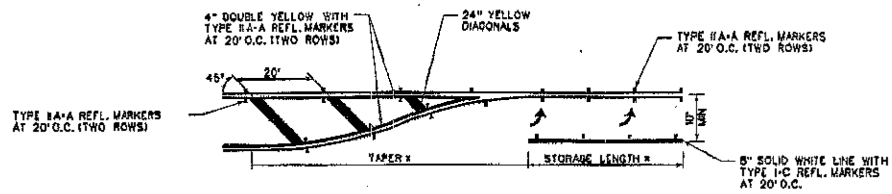
SHEET 10 OF 16

# SUBMITTAL	PROJECT NO.:		DATE:
DRWN. BY: LAN	DESN. BY: J.B.V.	CHKD. BY: M.E.	SHEET NO.: OF

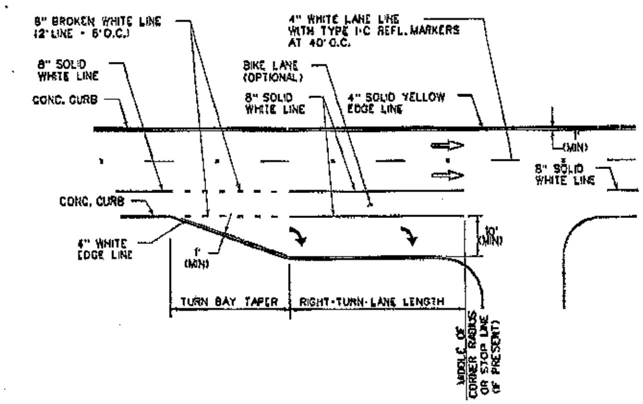
PAINTED MEDIAN LEFT TURN BAY DETAILS

* USE MINIMUM TURN BAY REVERSE CURVE TAPER LENGTH AND MINIMUM STORAGE LENGTH TABLES FOR "LEFT-TURN LANE (RAISED MEDIAN)" ON SHEET 10 OF 15.





UNSIGNALIZED RIGHT-TURN LANE



MINIMUM TURN BAY TAPER LENGTH	
POSTED SPEED (MPH)	LENGTH (FT)
30 OR LESS	90'
35 OR MORE	120'

MINIMUM RIGHT-TURN LANE LENGTH	
POSTED SPEED (MPH)	LENGTH (FT)
40 OR LESS	110'
45 OR MORE	150'

NOTES:

1. THE POSTED SPEED LIMIT IS TYPICALLY EQUAL TO THE DESIGN SPEED MINUS 5 MPH.
2. THE DIMENSIONS GIVEN FOR DUAL LEFT (RAISED MEDIAN) IN THE MINIMUM LENGTH TABLES ON THIS SHEET ARE ALSO APPLICABLE FOR DUAL RIGHT-TURN LANES.
3. STORAGE LENGTHS LONGER THAN THE MINIMUMS LISTED ON THIS DRAWING MAY BE DETERMINED USING TRAFFIC ENGINEERING ANALYSIS OR APPROXIMATE CALCULATIONS.
4. FOR THE PLACEMENT OF PAVEMENT ARROWS AND WORDS SEE LEFT-TURN "ONLY" AND ARROW SPACING WORKSHEET.
5. REFER TO APPLICABLE STANDARD PAVEMENT MARKINGS WITH REFLECTIVE RAISED PAVEMENT MARKERS FOR POSITION GUIDANCE AND LEFT-TURN & RIGHT-TURN LANE STANDARD PAVEMENT MARKINGS WITH REFLECTIVE RAISED PAVEMENT MARKINGS.
6. REFER TO BICYCLE LANE PAVEMENT MARKINGS STANDARD FOR TYPE AND PLACEMENT.
7. 4" SOLID WHITE AND YELLOW EDGE LINES ARE OPTIONAL AS DIRECTED BY THE CITY TRAFFIC ENGINEER.

SEPTEMBER 2009

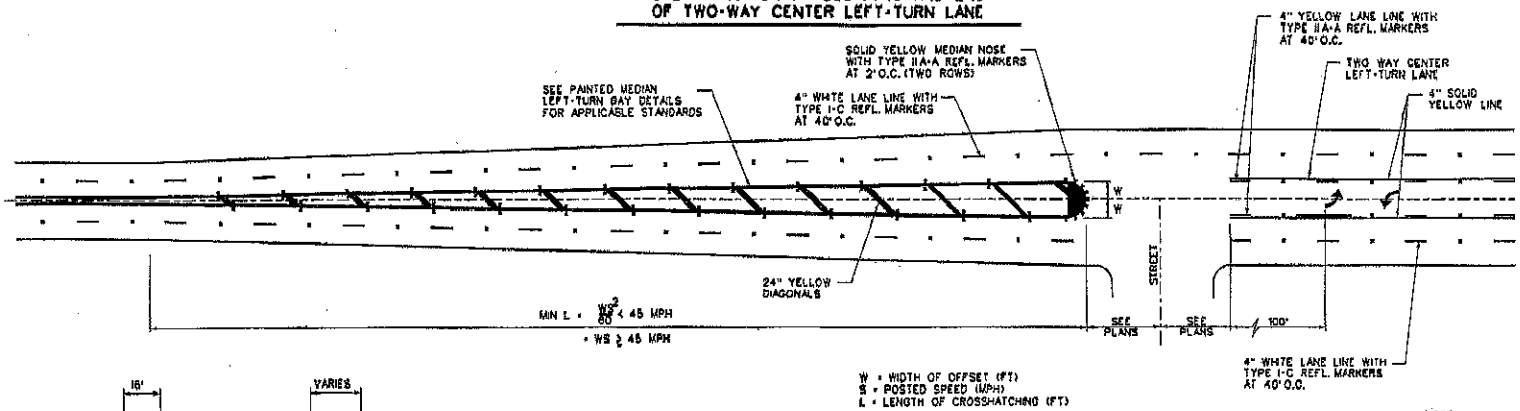
CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS
TRAFFIC ENGINEERING STANDARDS

LEFT-TURN LANE & RIGHT-TURN LANE DESIGN WORKSHEET 2

SHEET 11 OF 16

% SUBMITTAL	PROJECT NO.		DATE:
DRWN BY: LAN	DSGN BY: D.E.V	CHKD BY: M.E.	SHEET NO. OF

TYPICAL TRANSITION AT BEGINNING AND END OF TWO-WAY CENTER LEFT-TURN LANE



W = WIDTH OF OFFSET (FT)
S = POSTED SPEED (MPH)
L = LENGTH OF CROSSHATCHING (FT)

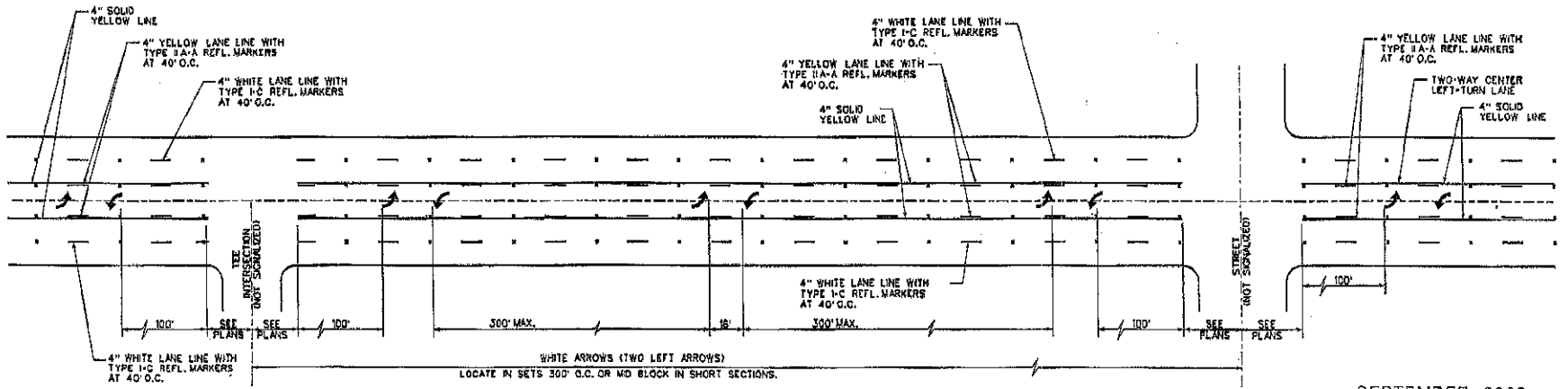
LEGEND
TYPICAL DETAIL

(PLACE LEGENDS IN ACCORDANCE TO LEFT TURN "ONLY" AND ARROW SPACING WORKSHEET)

NOTES:

1. REFLECTIVE RAISED PAVEMENT MARKERS SHOULD BE IN ACCORDANCE WITH STANDARD PAVEMENT MARKINGS WITH REFLECTIVE RAISED PAVEMENT MARKERS FOR POSITION GUIDANCE AND LEFT-TURN & RIGHT-TURN LANE STANDARD PAVEMENT MARKINGS WITH REFLECTIVE RAISED PAVEMENT MARKERS.
2. SEE LEFT-TURN & RIGHT-TURN LANE DESIGN WORKSHEET FOR APPLICABLE INFORMATION.
3. SEE LEFT-TURN "ONLY" AND ARROW SPACING WORKSHEET.

TWO-WAY LEFT-TURN LANE DETAILS NON-SIGNALIZED INTERSECTIONS



SEPTEMBER 2009

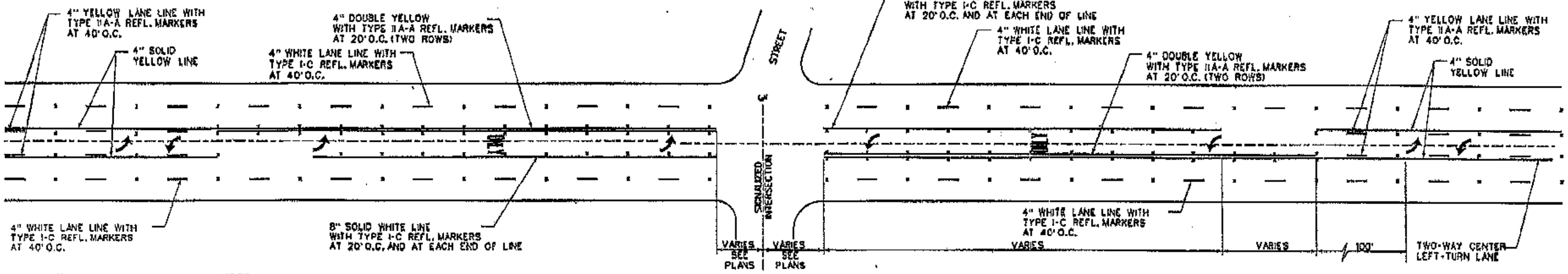
CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

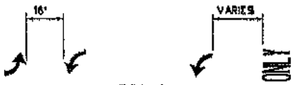
TRAFFIC ENGINEERING STANDARDS
TWO-WAY LEFT-TURN LANE DETAILS 1
SHEET 12 OF 16

% SUBMITTAL	PROJECT NO.:		DATE:
DRAWN BY:	CHKD. BY:	DESIGN BY:	SHEET NO.:

TYPICAL TWO-WAY LEFT-TURN LANE DETAILS

SIGNALIZED INTERSECTION

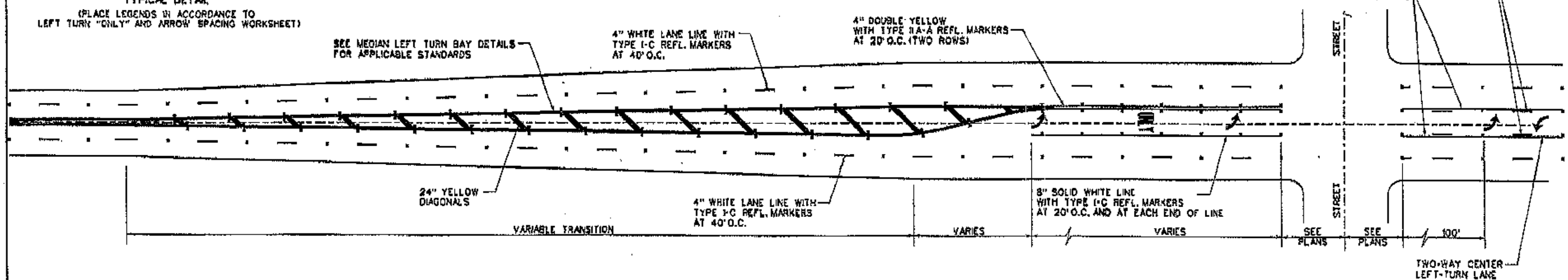




LEGEND
TYPICAL DETAIL
(PLACE LEGENDS IN ACCORDANCE TO LEFT TURN "ONLY" AND ARROW SPACING WORKSHEET)

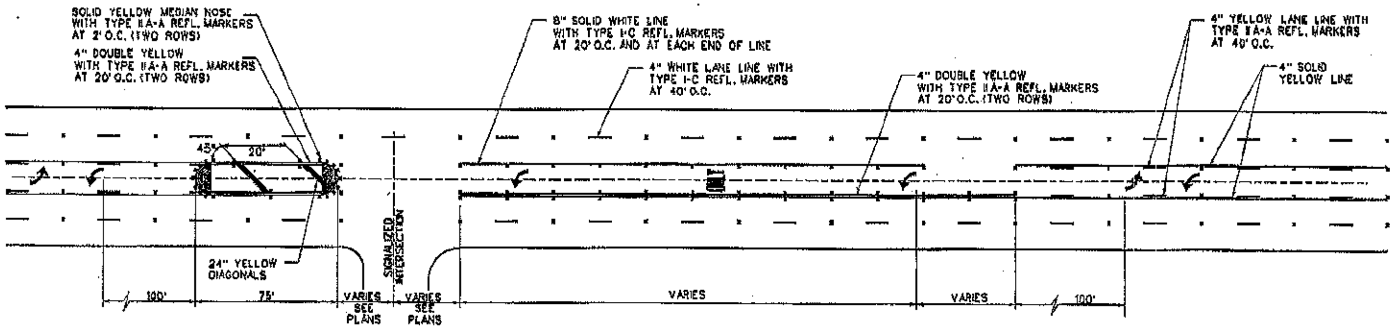
TYPICAL MEDIAN LEFT TURN BAY

SIGNALIZED AND NON-SIGNALIZED CROSS STREETS AT BEGINNING AND END OF TWO-WAY CENTER LEFT-TURN LANE



TYPICAL TWO-WAY LEFT-TURN LANE DETAILS

SIGNALIZED TEE INTERSECTION



NOTE:

1. REFLECTIVE RAISED PAVEMENT MARKERS SHOULD BE IN ACCORDANCE WITH STANDARD PAVEMENT MARKINGS WITH REFLECTIVE RAISED PAVEMENT MARKERS FOR POSITION GUIDANCE AND LEFT-TURN & RIGHT-TURN LANE STANDARD PAVEMENT MARKINGS WITH REFLECTIVE RAISED PAVEMENT MARKERS.
2. SEE LEFT-TURN & RIGHT-TURN LANE DESIGN WORKSHEET FOR APPLICABLE INFORMATION.
3. SEE LEFT-TURN "ONLY" AND ARROW SPACING WORKSHEET.

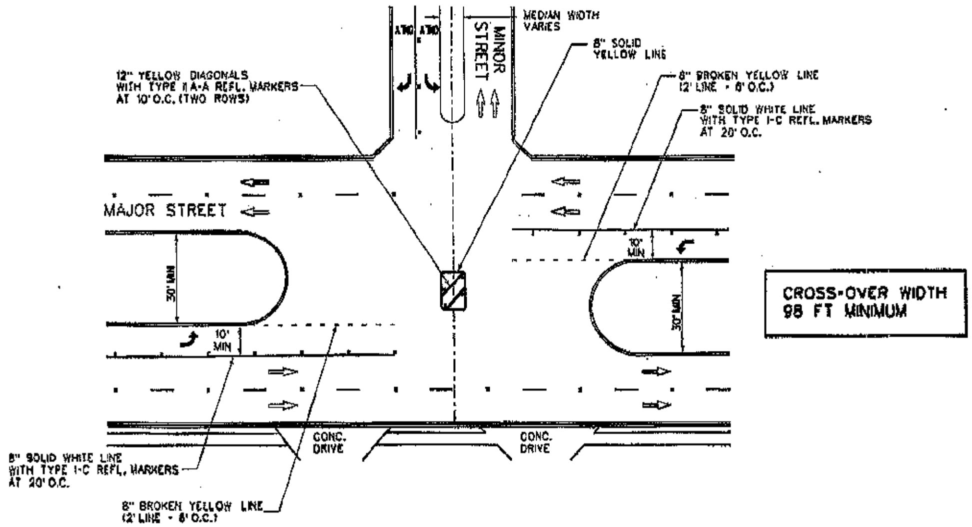
SEPTEMBER 2009

CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

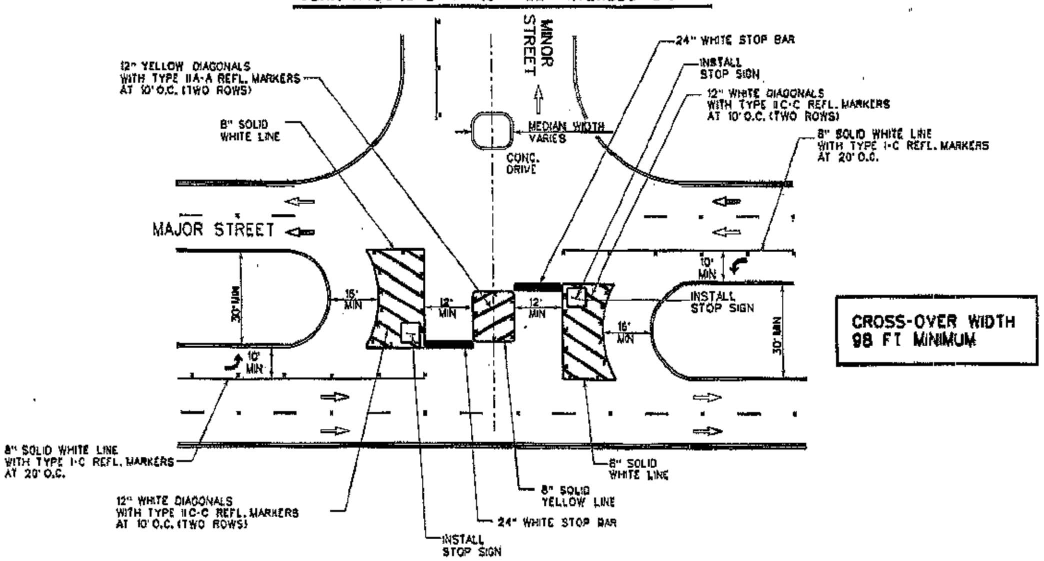
TRAFFIC ENGINEERING STANDARDS
TWO-WAY LEFT-TURN LANE DETAILS 2
SHEET 13 OF 18

% SUBMITTAL	PROJECT NO:		DATE:
DRAWN BY: LEH	DSGN BY: C.B.V.	CHKD BY: M.P.	SHEET NO: CF

CROSS-OVER MEDIAN OPENING WITHOUT TURN AROUND STRIPING "TEE" INTERSECTION



CROSS-OVER MEDIAN OPENING WITH TURN AROUND STRIPING "TEE" INTERSECTION



NOTE:

1. REFER TO LEFT TURN "ONLY" AND ARROW SPACING WORKSHEET.
2. SEE MISC. CROSS-OVER DETAIL FOR APPLICABLE INFORMATION.
3. ALL MEDIANS SHALL BE FIELD MEASURED TO DETERMINE THE LOCATION OF NECESSARY STRIPING, STOP BARS AND CENTERLINES SHALL BE PLACED WHEN THE MEDIAN WIDTH IS GREATER THAN 30 FT.
4. THE MEDIAN WIDTH IS DEFINED AS THE AREA BETWEEN TWO ROADWAYS OF A DIVIDED HIGHWAY MEASURED FROM EDGE OF TRAVELED WAY TO EDGE OF TRAVELED WAY. THE MEDIAN EXCLUDES TURN LANES.
5. THE MEDIAN WIDTH MIGHT BE DIFFERENT BETWEEN INTERSECTIONS, INTERCHANGES AND OF OPPOSITE APPROACHES OF THE SAME INTERSECTION.
6. THE NARROW MEDIAN WIDTH WILL BE THE CONTROLLING WIDTH TO DETERMINE IF MARKINGS ARE REQUIRED.

SEPTEMBER 2009

CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

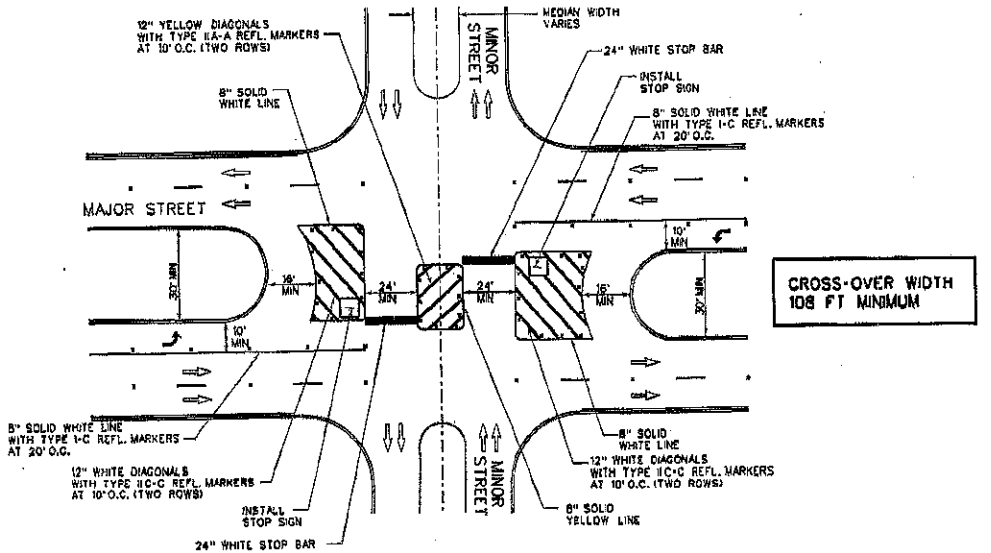
TRAFFIC ENGINEERING STANDARDS

STANDARD CROSS-OVER MEDIAN OPENING 1

SHEET 14 OF 19

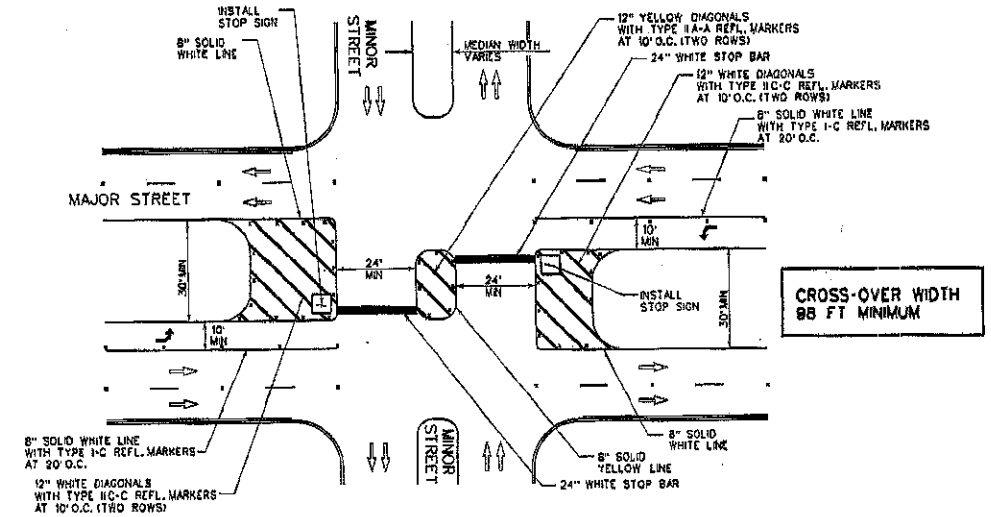
% SUBMITTAL	PROJECT NO.:		DATE:
DRWN. BY: LAH	DSGN BY: C.R.V.	CHKD. BY: M.E.	SHEET NO.:

CROSS-OVER MEDIAN OPENING WITH TURN AROUND STRIPING FOUR-WAY INTERSECTION



CROSS-OVER WIDTH 108 FT MINIMUM

CROSS-OVER MEDIAN OPENING WITHOUT TURN AROUND STRIPING FOUR-WAY INTERSECTION



CROSS-OVER WIDTH 98 FT MINIMUM

NOTE:

1. REFER TO LEFT TURN "ONLY" AND ARROW SPACING WORKSHEET.
2. SEE MISC. CROSS-OVER DETAIL FOR APPLICABLE INFORMATION.
3. ALL MEDIANS SHALL BE FIELD MEASURED TO DETERMINE THE LOCATION OF NECESSARY STRIPING. STOP BARS AND CENTERLINES SHALL BE PLACED WHEN THE MEDIAN WIDTH IS GREATER THAN 30 FT.
4. THE MEDIAN WIDTH IS DEFINED AS THE AREA BETWEEN TWO ROADWAYS OF A DIVIDED HIGHWAY MEASURED FROM EDGE OF TRAVELED WAY TO EDGE OF TRAVELED WAY. THE MEDIAN EXCLUDES TURN LANES.
5. THE MEDIAN WIDTH MIGHT BE DIFFERENT BETWEEN INTERSECTIONS, INTERCHANGES AND OF OPPOSITE APPROACHES OF THE SAME INTERSECTION.
6. THE NARROW MEDIAN WIDTH WILL BE THE CONTROLLING WIDTH TO DETERMINE IF MARKINGS ARE REQUIRED.

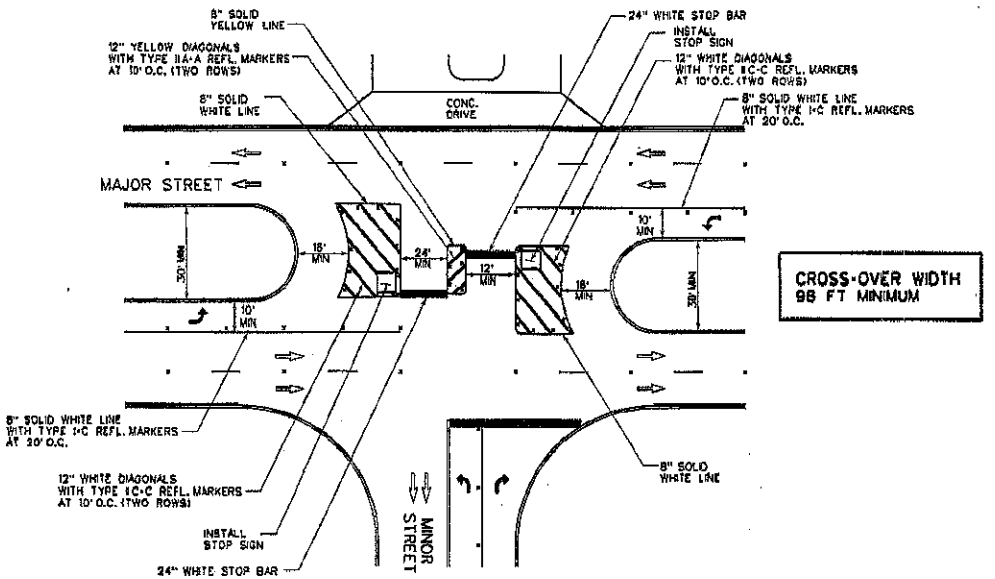
SEPTEMBER 2009

CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

TRAFFIC ENGINEERING STANDARDS
STANDARD CROSS-OVER MEDIAN OPENING 2
SHEET 15 OF 16

M SUBMITTAL	PROJECT NO.:		DATE:
DRWN. BY: LAH	DSGN. BY: CSV	CHKD. BY: MP	SHEET NO.: OF

CROSS-OVER MEDIAN OPENING WITH TURN AROUND STRIPING "TEE" INTERSECTION



CROSS-OVER WIDTH 98 FT MINIMUM

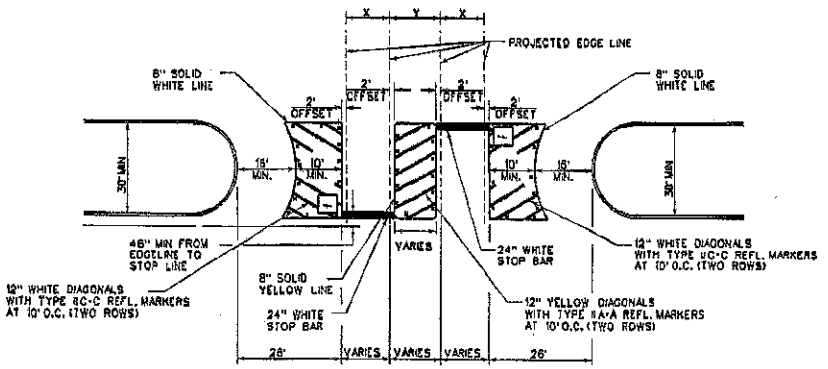
NOTE:

1. REFER TO LEFT TURN "ONLY" AND ARROW SPACING WORKSHEET.
2. SEE MISC. CROSS-OVER DETAIL FOR APPLICABLE INFORMATION.
3. ALL MEDIANS SHALL BE FIELD MEASURED TO DETERMINE THE LOCATION OF NECESSARY STRIPING. STOP BARS AND CENTERLINES SHALL BE PLACED WHEN THE MEDIAN WIDTH IS GREATER THAN 30 FT.
4. THE MEDIAN WIDTH IS DEFINED AS THE AREA BETWEEN TWO ROADWAYS OF A DIVIDED HIGHWAY MEASURED FROM EDGE OF TRAVELED WAY TO EDGE OF TRAVELED WAY. THE MEDIAN EXCLUDES TURN LANES.
5. THE MEDIAN WIDTH MIGHT BE DIFFERENT BETWEEN INTERSECTIONS, INTERCHANGES AND OF OPPOSITE APPROACHES OF THE SAME INTERSECTION.
6. THE NARROW MEDIAN WIDTH WILL BE THE CONTROLLING WIDTH TO DETERMINE IF MARKINGS ARE REQUIRED.

MISCELLANEOUS CROSS-OVER DETAIL WITH TURN AROUND STRIPING

NOTE:

1. X - ROADWAY WIDTH AND NUMBER OF LANES VARIES
2. Y - MEDIAN WIDTH VARIES



SEPTEMBER 2009

CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

TRAFFIC ENGINEERING STANDARDS

STANDARD CROSS-OVER MEDIAN OPENING 3

SHEET 16 OF 16

# SUBMITTAL	PROJECT NO:				DATE:
DRWN. BY:	LAY	DSGN. BY:	CBV	CHKD. BY:	MS	SHEET NO:	OF

GENERAL NOTES

1.) THE EXISTING SIGNS LOCATED ON THE JOBSITE ARE THE PROPERTY OF THE CITY OF SAN ANTONIO. THROUGHOUT THE PERIOD OF THE CONTRACT, THE CONTRACTOR SHALL PROTECT THESE SIGNS SUCH THAT THEY ARE NOT DAMAGED IN THE COURSE OF CONSTRUCTION ACTIVITY. SUCH PROTECTION SHALL INCLUDE THE PERIOD AFTER SIGNS ARE REMOVED FROM INSTALLATION AND STORED BY THE CONTRACTOR OR DELIVERED TO TRAFFIC OPERATIONS. THE ASSISTANT TRAFFIC SUPERINTENDENT (207-7765) MUST BE NOTIFIED 48 HOURS IN ADVANCE PRIOR TO DELIVERY.

2.) AFTER SIGNS ARE REMOVED FROM INSTALLATION AND ARE BEING STORED BY THE CONTRACTOR, THE CONTRACTOR SHALL CONTACT THE TRAFFIC OPERATIONS SECTION OF THE PUBLIC WORKS DEPARTMENT (207-7765) AND ARRANGE FOR A CONVENIENT TIME TO DELIVER CITY SIGNS AND POLES.

3.) PRIOR TO THE START OF CONSTRUCTION, ALL EXISTING SIGNS WITHIN THE AREA OF CONSTRUCTION WILL BE INVENTORIED AND DOCUMENTED JOINTLY BY THE TRAFFIC ENGINEERING (207-7720) CONSTRUCTION INSPECTION AND THE CONTRACTOR. THIS DOCUMENT WILL BE JOINTLY SIGNED BY BOTH PARTIES REFLECTING THE SIGN TYPE, SIGN SIZE, SIGN CONDITION, SIGN LOCATION, REFLECTIVITY ADEQUACY, ETC. THE CONTRACTOR IS HELD ACCOUNTABLE FOR THESE SIGNS THROUGHOUT THE PROJECT AND AT THE PROJECTS COMPLETION.

4.) ALL GROUND MOUNTED SIGNS SHALL USE HIGH INTENSITY REFLECTIVE SHEETING.

5.) ALL OVERHEAD SIGNS SHALL USE DIAMOND GRADE REFLECTIVE SHEETING.

6.) ALL BLANKS TO BE ALUMINUM ALLOY NO. 5052-H38.

7.) "T" DENOTES THICKNESS OF SIGN BLANKS.

8.) ALL HOLES SHALL BE 3/8" DIAMETER DRILLED OR PUNCHED AS SHOWN ON EACH BLANK DETAIL AND SHALL BE FREE OF BURRS AND/OR ROUGH EDGES.

9.) SIGN BLANK CORNERS TO BE ROUNDED AS SHOWN ON EACH DETAIL.

10.) ALL SIGN BLANK TO BE ETCHED, DEGREASED, AND HAVE AN ALODINE FINISH PRIOR TO APPLICATION OF LEGENDS.

11.) ALL DETAILS ARE NOT TO SCALE.

12.) ALL DIMENSIONS ARE IN INCHES.

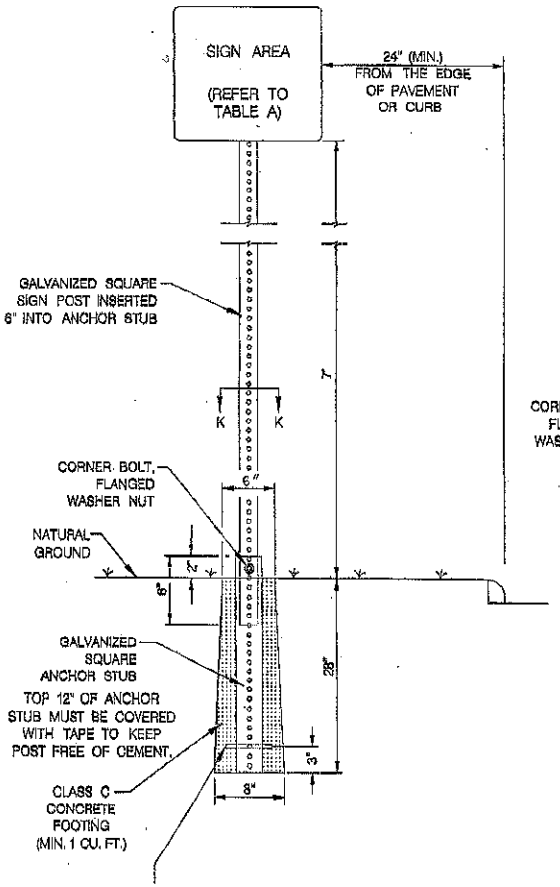
13.) ALL SIGNS SHALL BE MANUFACTURED AND INSTALLED IN CONFORMANCE TO THE TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES AND STANDARD HIGHWAY SIGNS (FHWA) LATEST EDITION.

14.) REINSTALLATION OF PREVIOUSLY EXISTING SIGNS, WHERE REQUIRED BY THE CITY TRAFFIC ENGINEER, SHALL BE AT THE CONTRACTOR'S EXPENSE.

TYPICAL GROUND SIGN INSTALLATION

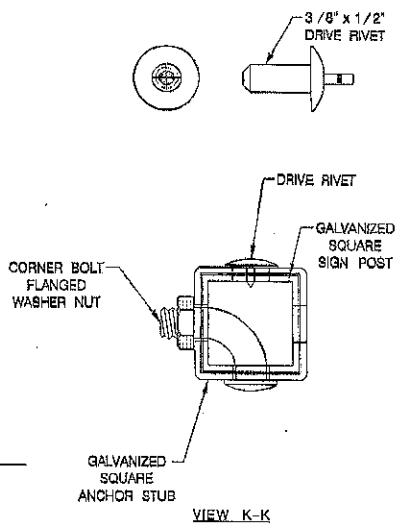
TYPE "U" MOUNT

PERFORATED SQUARE METAL TUBING (DRIVEABLE)



METAL TUBING	SIGN AREA	
	≤ 10 SQ. FT.	> 10 SQ. FT.
GALVANIZED SQUARE SIGN POST (PERFORATED)	1-3/4" x 1-3/4" (14 GAUGE)	2" x 2" (12 GAUGE)
GALVANIZED SQUARE ANCHOR STUB (PERFORATED)	2" X 2" (14 GAUGE)	2-1/4" x 2-1/4" (14 GAUGE)

TABLE A



VIEW K-K

THE ORIGINAL OF THIS DRAWING WAS SIGNED AND SEALED BY EDWARD N. MERY, P.E., #58698 ON 02.06.06 AND IS ON FILE WITH THE TRAFFIC ENGINEERING DIVISION OF THE PUBLIC WORKS DEPARTMENT, CITY OF SAN ANTONIO.

FEBRUARY 2006

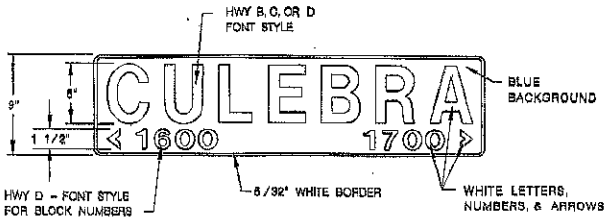
CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

TRAFFIC SIGN STANDARDS

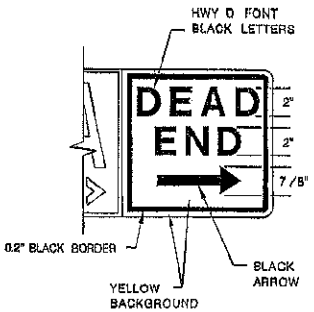
GENERAL NOTES AND GROUND SIGN MOUNTING

SHEET 1 OF 4

# SUBMITTAL	PROJECT NO.		DATE
DRWN. BY: A.F.G.	DSGN. BY: E.N.M.	CHKD. BY: J.D.R./E.N.M.	SHEET NO.: OF



9" D3 – STREET NAME SIGN



NEW 9" D3 W / DEAD END OR NO OUTLET SIGNAGE

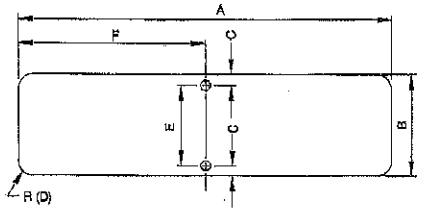
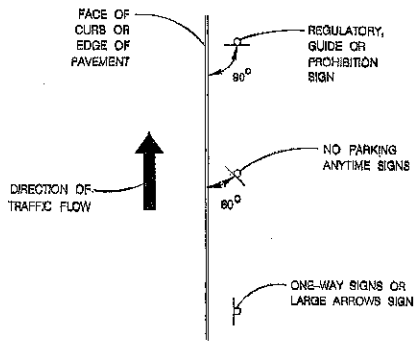


TABLE – D3 SIGNS

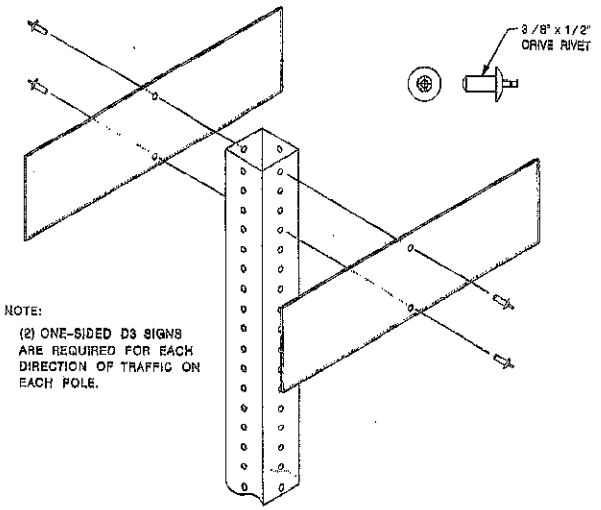
A	B	C	D	E	F	T
24"	9"	1/2"	3/4"	8"	12"	0.125"
30"	9"	1/2"	3/4"	8"	15"	0.125"
36"	9"	1/2"	3/4"	8"	18"	0.125"
42"	9"	1/2"	3/4"	8"	21"	0.125"
48"	9"	1/2"	3/4"	8"	24"	0.125"
54"	9"	1/2"	3/4"	8"	27"	0.125"

NOTE: A 30" LONG OR GREATER PLATE SHALL BE USED WHEN A "DEAD END" OR "NO OUTLET" SUPPLEMENT IS REQUIRED.

HEIGHT	9" (228 mm)
LENGTH	24" (600 MM) MIN. 54 (1350 MM) MAX. 6" (150 MM) INCREMENTS OF LENGTH
THICKNESS	0.125" (3MM)
SUBSTRATE	ALUMINUM ALLOY, 5052-H38 (ASTM B-209) GOLD CHROMATE FINISH
SIGN FACE MATERIALS	BLUE FILM OVER HIGH INTENSITY FP-85, SECTION 718 AND L-S-300C
LEGENDS AND SYMBOLS	SERIES D (USUAL) SERIES C OR B FOR MAXIMUM LENGTH SIGN BLANK, IF NECESSARY
COLOR	WHITE LEGEND ON BLUE BACKGROUND
LETTER TRACKING	10%



TYPICAL GROUND MOUNTED SIGN PLACEMENT



NOTE:
(2) ONE-SIDED D3 SIGNS ARE REQUIRED FOR EACH DIRECTION OF TRAFFIC ON EACH POLE.

D3 SIGN TO POLE INSTALLATION

THE ORIGINAL OF THIS DRAWING WAS SIGNED AND SEALED BY EDWARD N. MERY, P.E., #58696 ON 02.06.06 AND IS ON FILE WITH THE TRAFFIC ENGINEERING DIVISION OF THE PUBLIC WORKS DEPARTMENT, CITY OF SAN ANTONIO.

FEBRUARY 2006

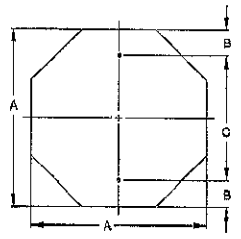
CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

TRAFFIC SIGN STANDARDS

D3 STREET NAME SIGN AND SIGN MOUNTING

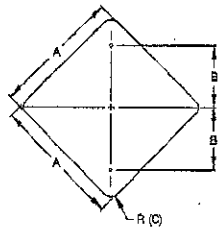
SHEET 2 OF 4

% SUBMITTAL | PROJECT NO. | DATE:
DRWN. BY: A.P.Q. | DSGN. BY: E.N.M. | CHKD. BY: J.D.E./E.N.M. | SHEET NO.: | OF



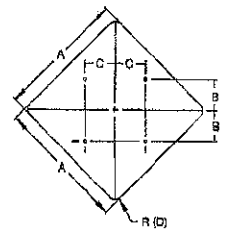
OCTAGONAL

A	B	C	T
24	9	18	0.080
30	9	24	0.080
36	9	30	0.100



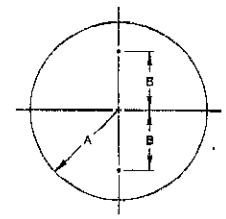
DIAMOND (A)

A	B	C	T
18	9	11/2	0.080
24	12	11/2	0.080
30	15	17/8	0.080
36	18	2 1/4	0.100



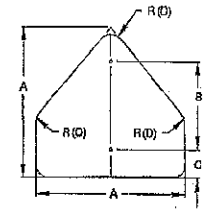
DIAMOND (B)

A	B	C	D	T
48	15	15	3	0.100



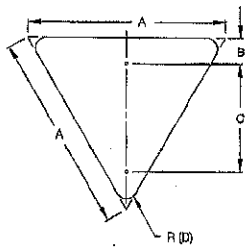
CIRCLE

A	B	T
18	16	0.100



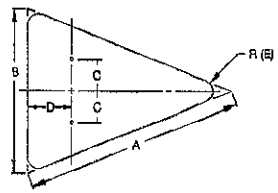
PENTAGON (SCHOOL)

A	B	C	D	T
96	24	3	2 1/4	0.100



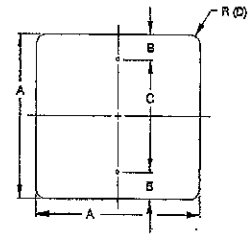
EQUILATERAL TRIANGLE

A	B	C	D	T
36	2	24	2	0.100



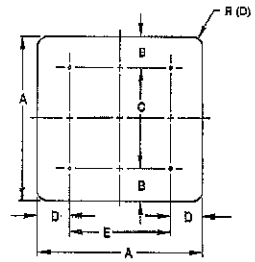
ISOSCELES TRIANGLE

A	B	C	D	E	T
40	30	7 1/2	12	17/8	0.100
48	36	9	16	2 1/4	0.100



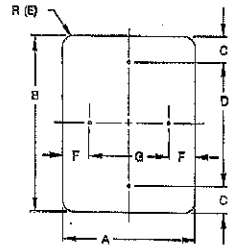
SQUARE (A)

A	B	C	D	T
18	9 1/2	15	11/2	0.080
24	3	18	11/2	0.080
30	3	24	17/8	0.080



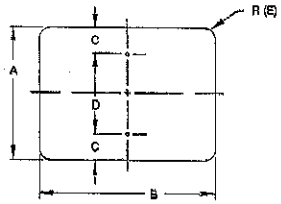
SQUARE (B)

A	B	C	D	E	F	T
48	6	36	9	30	3	0.100



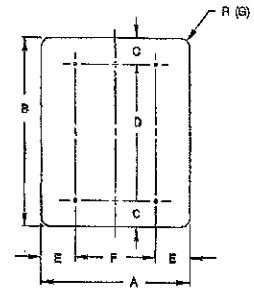
VERTICAL / HORIZONTAL RECTANGLE

A	B	C	D	E	F	G	T
12	18	11/2	15	11/2	11/2	6	0.080
12	36	3	30	11/2	11/2	9	0.080
18	24	11/2	21	11/2	11/2	15	0.080
24	30	3	24	11/2	3	18	0.080
24	36	3	30	11/2	3	18	0.080
24	48	6	36	17/8	3	18	0.080
30	36	3	30	17/8	3	24	0.080



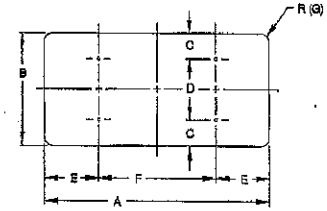
HORIZONTAL RECTANGLE

A	B	C	D	E	T
6	12	1	4	1/4	0.080
6	18	1	4	1/4	0.080
20	36	11/2	17	11/2	0.080



VERTICAL RECTANGLE

A	B	C	D	E	F	G	T
6	7 3/4	1/2	8 3/4	1/2	4	1/4	0.100
48	60	6	48	9	30	9	0.100



HORIZONTAL RECTANGLE

A	B	C	D	E	F	G	T
48	24	2	20	2	44	1 7/8	0.100
48	36	3	30	3	42	2 1/4	0.100
60	24	2	20	2	56	11/2	0.100
60	36	3	30	3	54	2 1/4	0.100
48	30	3	24	3	42	17/8	0.100
60	30	3	24	3	54	17/8	0.100

THE ORIGINAL OF THIS DRAWING WAS SIGNED AND SEALED BY EDWARD N. MERY, P.E., #66598 ON 02.06.06 AND IS ON FILE WITH THE TRAFFIC ENGINEERING DIVISION OF THE PUBLIC WORKS DEPARTMENT, CITY OF SAN ANTONIO.

FEBRUARY 2006

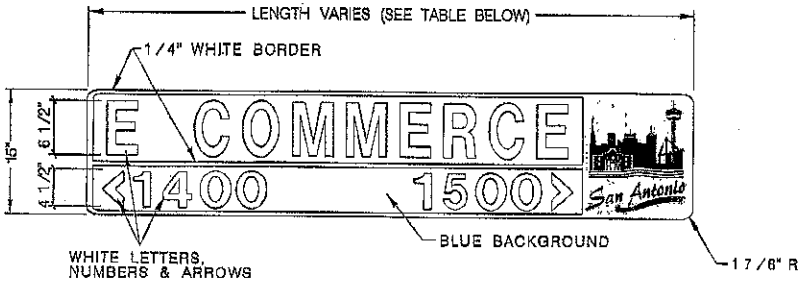
CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

TRAFFIC SIGN STANDARDS

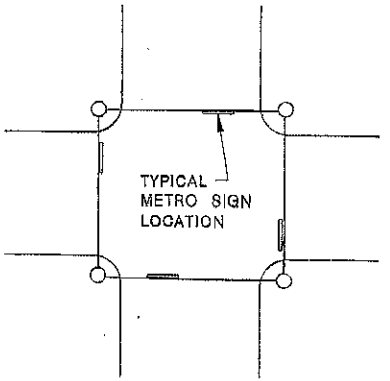
GROUND MOUNTED SIGN SIZES

SHEET 3 OF 4

# SUBMITTAL	PROJECT NO.:		DATE:
DRWN. BY: A.P.G.	DSGN. BY: E.N.M.	CHKD. BY: J.D.F./E.N.M.	SHEET NO.: 3 OF 4

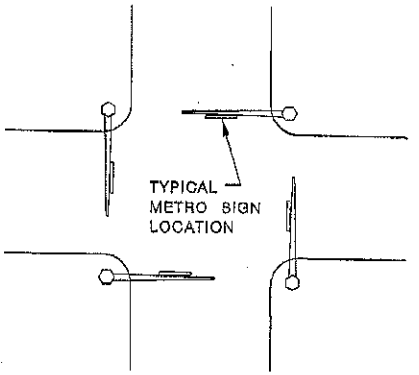


15" METRO – STREET NAME SIGNS



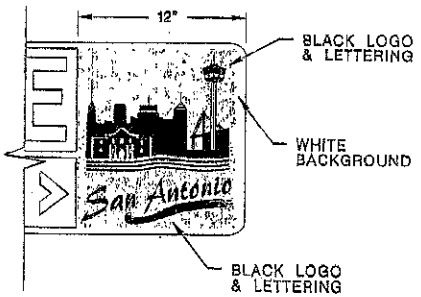
SPAN WIRE INSTALLATION

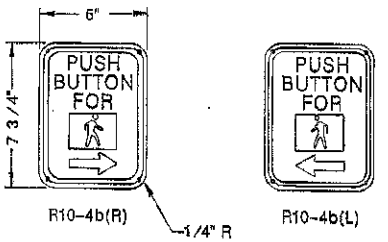
TYPICAL METRO SIGN PLACEMENT



MAST ARM INSTALLATION

15" METRO w/CITY SKY LINE



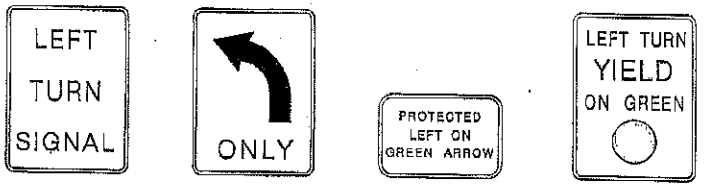


PEDESTRIAN PUSHBUTTON SIGNS

HEIGHT	15" (381 MM)
LENGTH	48" (1200 MM) MIN. 72" (1800 MM) MAX.** 1' (300 MM) INCREMENTS OF LENGTH
THICKNESS	0.125" (3 MM)
SUBSTRATE	ALUMINUM ALLOY, 5052-H38 (ASTM B-209) GOLD CHROMATE FINISH
SIGN FACE MATERIALS	BLUE FILM OVER DIAMOND GRADE FP-85, SECTION 718 AND L-S-300C
LEGENDS AND SYMBOLS	SERIES D (USUAL) SERIES C OR B FOR MAXIMUM LENGTH SIGN BLANK, IF NECESSARY
COLOR	WHITE LEGEND ON BLUE BACKGROUND
LETTER TRACKING	17% (USUAL) 10% (MIN.)

** SIGN PLATE LONGER THAN 72" MUST BE APPROVED BY THE CITY TRAFFIC ENGINEER

* DIAMOND GRADE SHEETING 5052-H38 ALUMINUM SUBSTRATE



R10-10 *(30" X 36")
R3-5L *(30" X 36")
R10-9 *(30" X 24")
R10-12 *(30" X 36")

LEFT TURN SIGNS

THE ORIGINAL OF THIS DRAWING WAS SIGNED AND SEALED BY EDWARD N. MERY, P.E., #85698 ON 02.06.06 AND IS ON FILE WITH THE TRAFFIC ENGINEERING DIVISION OF THE PUBLIC WORKS DEPARTMENT, CITY OF SAN ANTONIO.

FEBRUARY 2006

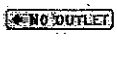
CITY OF SAN ANTONIO
DEPARTMENT OF PUBLIC WORKS

TRAFFIC SIGN STANDARDS

METRO STREET NAME SIGN AND SIGN PLACEMENT
SHEET 1 OF 4

N SUBMITTAL	PROJECT NO.					DATE:	
DRWN. BY: A.F.G.	DSGN. BY: E.N.M.	CHKD. BY: J.D.F./E.N.M.				SHEET NO.: 01	

531.59
Special Sign*



531.60
W14-2p
No Outlet*
36" x 9"

531.61
S5-1
School Speed
Limit When Flashing***
24" x 48"

531.62
W16-9p
AHEAD**
36" x 20"

531.63
W16-2
XXX FT**
30" x 18"

531.64
W13-1
30mph Adv**
18" x 18"

531.65
S4-3a
School Zone*
Arrow
24" x 18"

531.66
S5-2a
END SCHOOL
ZONE*
24" x 9"

531.67
R9-6 YIELD TO PEDS*
12"X18"

531.68
R3-17 BIKE LANE*
30"X24"

531.69
R3-17a AHEAD*
30"X12"

531.70
R3-17b ENDS*
30"X12"

531.71
R4-4 BRTLYB*
36"X30"

531.72
R1-2 YIELD*
18"X18"X18"

531.73
W11-1 BIKE Warning*
30"X30"

531.74
R5-3 NMV*
24"X24"

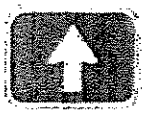
531.75
D11-1 BIKE ROUTE*
24"X18"

531.76
M4-11 PLAQUE*
12"X4"

531.77
M4-12 PLAQUE*
12"X4"

531.78
M4-13 PLAQUE*
12"X4"

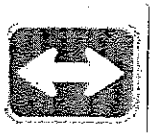
531.79
M7-1 PLAQUE*
12"X9"



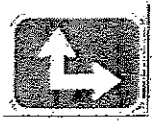
531.80
M7-2 PLAQUE*
12"X9"

531.81
M7-3 PLAQUE*
12"X9"

531.82
M7-4 PLAQUE*
12"X9"



531.83
M7-5 PLAQUE*
12"X9"



531.84
M7-6 PLAQUE*
12"X9"

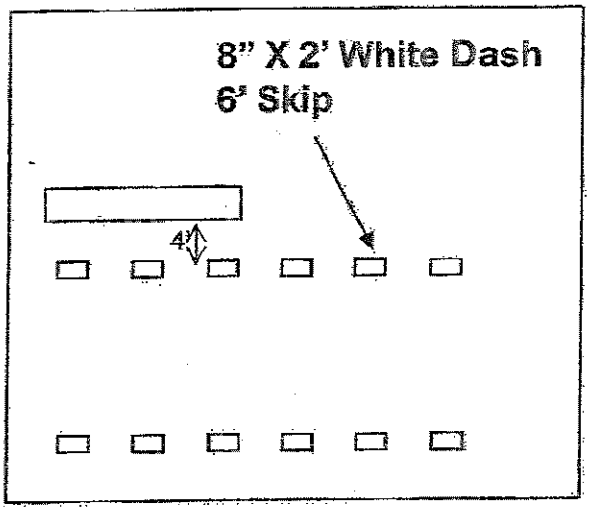
531.85
M7-7 PLAQUE*
12"X9"

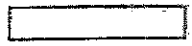
* High Intensity

** Diamond Grade
(Fluorescent Yellow Green)

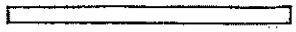
*** Diamond Grade
(Fluorescent Yellow Green)
w/High Intensity White
Background

NOTE: All overhead mounted signs shall be Diamond Grade

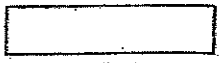




535-E
536.5
12" Wide White Line

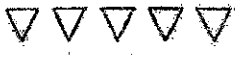


535-D
536.4
8" Wide White Line



535-G
536.7
24" Wide White Line

535-A
536.1
4" X 3' Yellow Dash
9' Skip

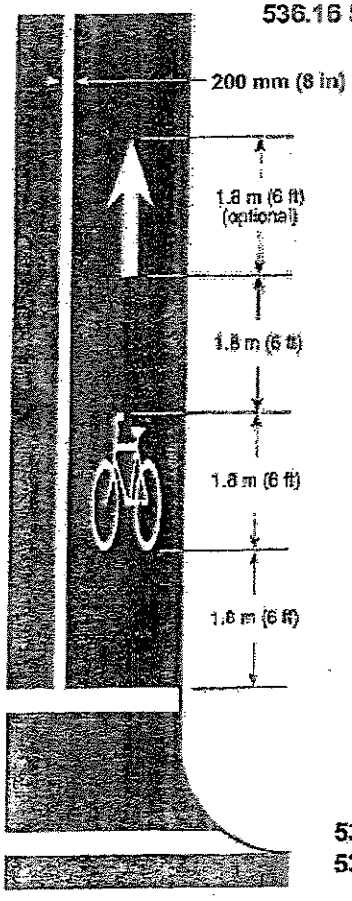


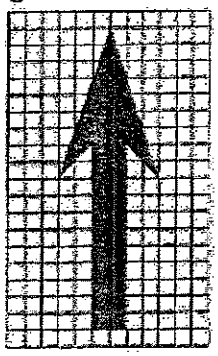
535-Q
536.18
Solid White
Yield Lines 6" x 9"
3" Gap

535-A
536.1
4" Solid Yellow
Centerline

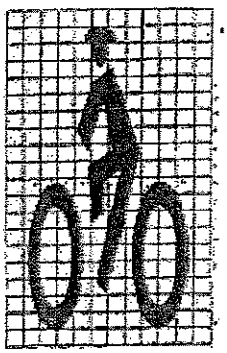
All Thermo Plastic Markings Machined Laid Only (Tape on Concrete)

535-O Straight White Arrow Bike Facility
536.16 Straight White Arrow Bike Facility





Directional arrow

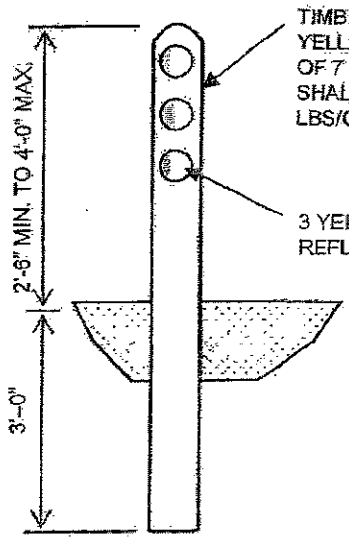


535-P Bicycle Rider Symbol
536.17 Bicycle Rider Symbol

536.20
535-S
White YIELD

536.19
535-R
White STOP

□ = 0.1 m x 0.1 m
(4 in x 4 in)



TIMBER POST SHALL BE SOUTHERN YELLOW PINE OR EQUAL, A MINIMUM OF 7 INCHE IN DIAMETER. POST SHALL BE TREATED WITH 0.4 LBS/CU.FT. DRY PENTACHLOROPHENOL.

3 YELLOW INDEPENDENTLY HOUSED REFLECTORS (3" DIA.) FRONT & BACK

TIMBER GUARD POST

SHARROW DETAIL

Figure 9C-9. Shared Lane Marking